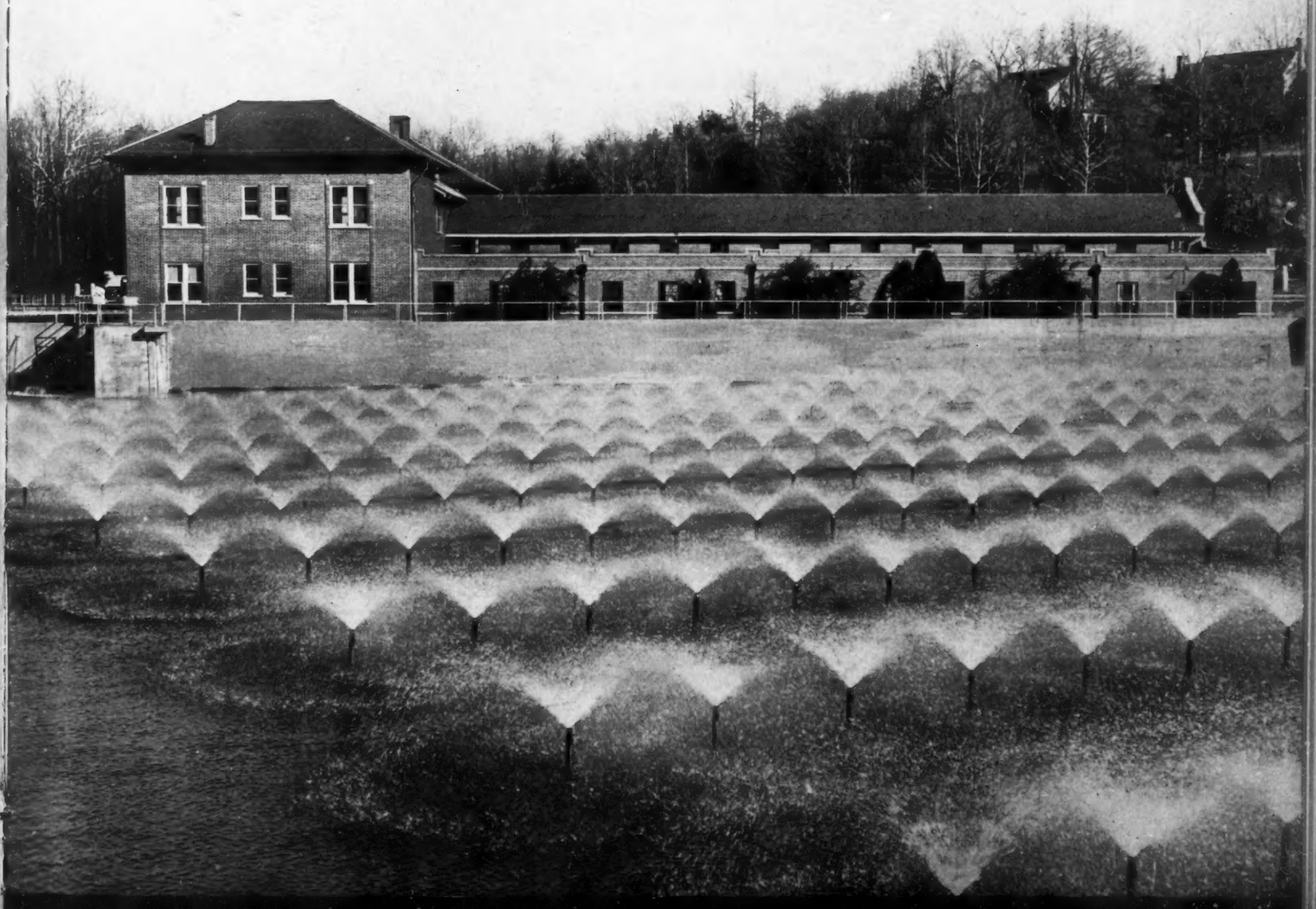
WATER WORKS & SEWERAGE

HBP ABC

THE FILTRATION PLANT OF RICHMOND, VA.



FOR water supply, gas supply, fire protection, and sanitation, cast iron pipe serves important needs in the construction of National Defense projects. We have, for ready shipment, large stocks of mechanical joint, bell-and-spigot and flanged Super-de Lavaud centrifugally cast pipe, pit-cast pipe and standard fittings in plant and storage yards throughout the country.
U. S. PIPE & FOUNDRY CO.
General Offices: Burlington, N. J.
Plants and Sales Offices Throughout the U. S. A.
U.S. cast iron PIPE
Centrifugally or Pit Cast for water works, gas, sewerage, drainage and industrial services.

Closed View—Showing Sturdy Construction and Rounded Corners for Easy Operation and Avoidance of Skinned Knuckles

THE latest addition to the "3C" line of Type "D" Heavy Duty Push Buttons, an oil immersed station, features the same sturdy mechanism used in preceding Type D Buttons. These Push Buttons are built in accordance with Underwriters' specifications for Class 1, Group D, Hazardous Locations, with or without oil. The addition of oil eliminates the action of corrosive gas, and smothers any arc generated at the contacts.

The case consists of a heavy cast iron upper section, to which are attached the Push Button units, and a cast iron oil tank, both with wide, accurately machined flanges, thus completely assuring the cooling of any flame which may be started by explosion in the enclosure.

Provision is also made for locking in the "OFF" or "STOP" position.

Each Push Button unit has a Normally Open and a Normally Closed Contact supplied as standard. Maintained Contact Push Buttons are also available.

The Push Button units are mounted on an easily removable insulating subbase, which also acts as a wire spacer.

Our nearest office or agency will gladly give you further details.

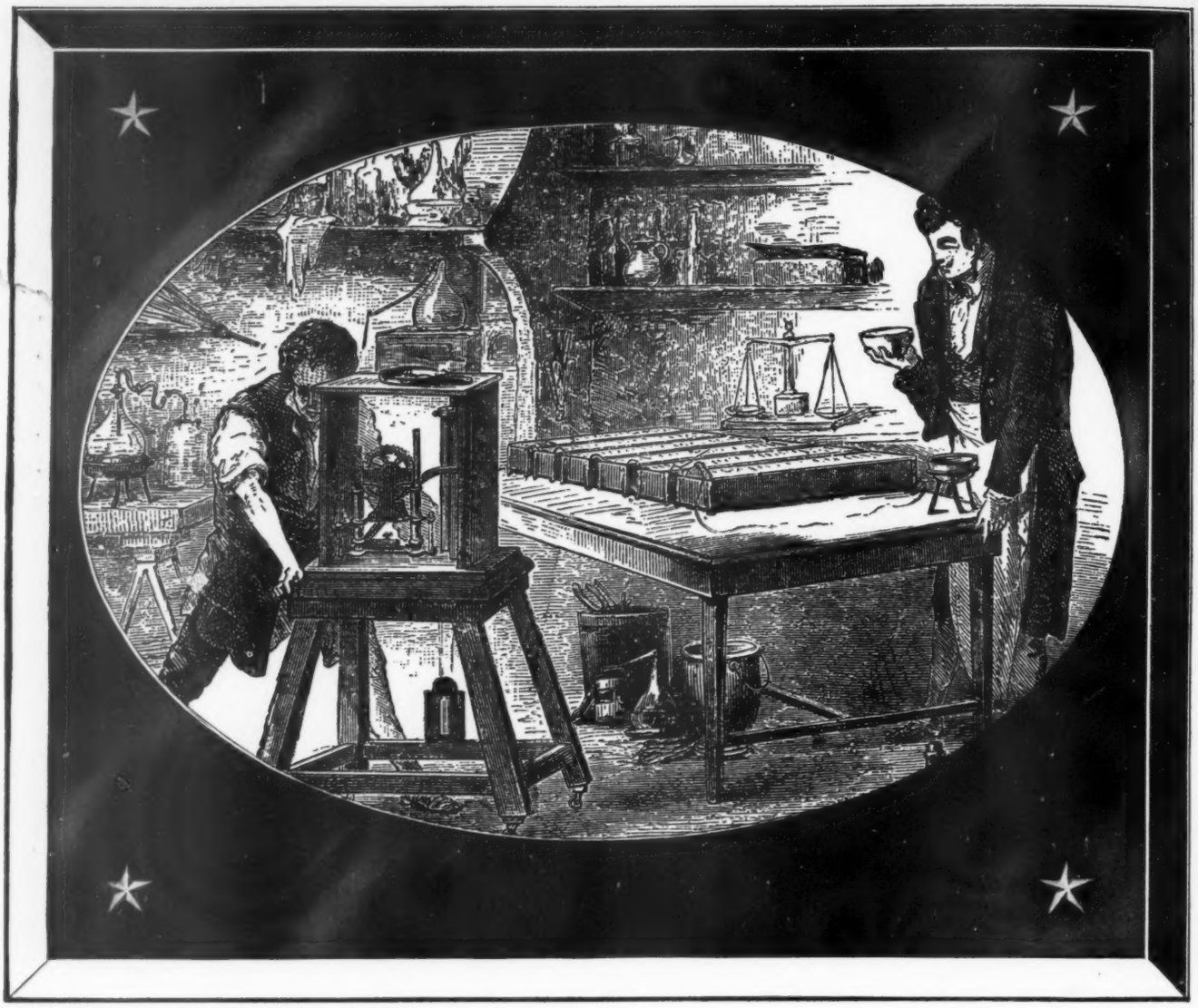
Open View—Note Wide, Accurately Machined Flanges and Full Capacity Oil Tank

CONTINUE TO ROLL WITH CLARK CONTROL

THE CLARK CONTROLLER CO.

1146 EAST 152ND ST. CLEVELAND, OHIO

WATER WORKS & SEWERAGE, December, 1940. *Volume* 87. Number 12. Published monthly at 330 South Wells Street, Chicago, Ill., by the Gillette Publishing Company. Per copy, 25c. Subscription rate, United States $2.00 per year; Canada $2.40 per year; Foreign $3.00 per year. Copyright, 1940. Entered as Second Class Matter, June 2, 1931, at the Post Office at Chicago, Ill., under Act of March 3, 1879.



They Started Something!

THE EXPERIMENTS of Sir Humphrey Davy were of inestimable importance in the course of industrial progress, in the relief of suffering, and in the preservation of life. When he first prepared metallic sodium by the electrolysis of alkalis, he gave industry a new raw material which today is constantly finding wider application. His discovery of the effects of nitrous oxide eventually paved the way for the development of anesthesia and gave science a potent weapon in the war against pain. Countless lives were saved when he found that a cylinder of wire gauze surrounding a flame prevents the flame from igniting explosive gases. This was the principle of the safety lamp that substantially reduced explosion hazards in the mining industry.

Both industrial progress and human health benefited immeasurably also from the work of the EBG engineers who first made Liquid Chlorine commercially available in America. EBG Liquid Chlorine gave municipal health authorities a new and effective method for controlling the spread of water-borne diseases, for assuring the purity of water supplies —and more recently for sterilizing sewage as an added safeguard to public health. The manufacturers of paper and textiles were enabled to set new standards of efficiency and economy through the use of EBG Liquid Chlorine as a bleaching agent. Pioneers in Liquid Chlorine production, EBG engineers have long experience in its manufacture and servicing — experience that works for you when you specify EBG Liquid Chlorine.

The first cylinder of Liquid Chlorine made by EBG in 1909.

ELECTRO BLEACHING GAS COMPANY
Main Office: 60 East 42nd Street, New York, N.Y.
Plant: Niagara Falls, N.Y.

EBG Liquid Chlorine
FIRST IN THE COUNTRY

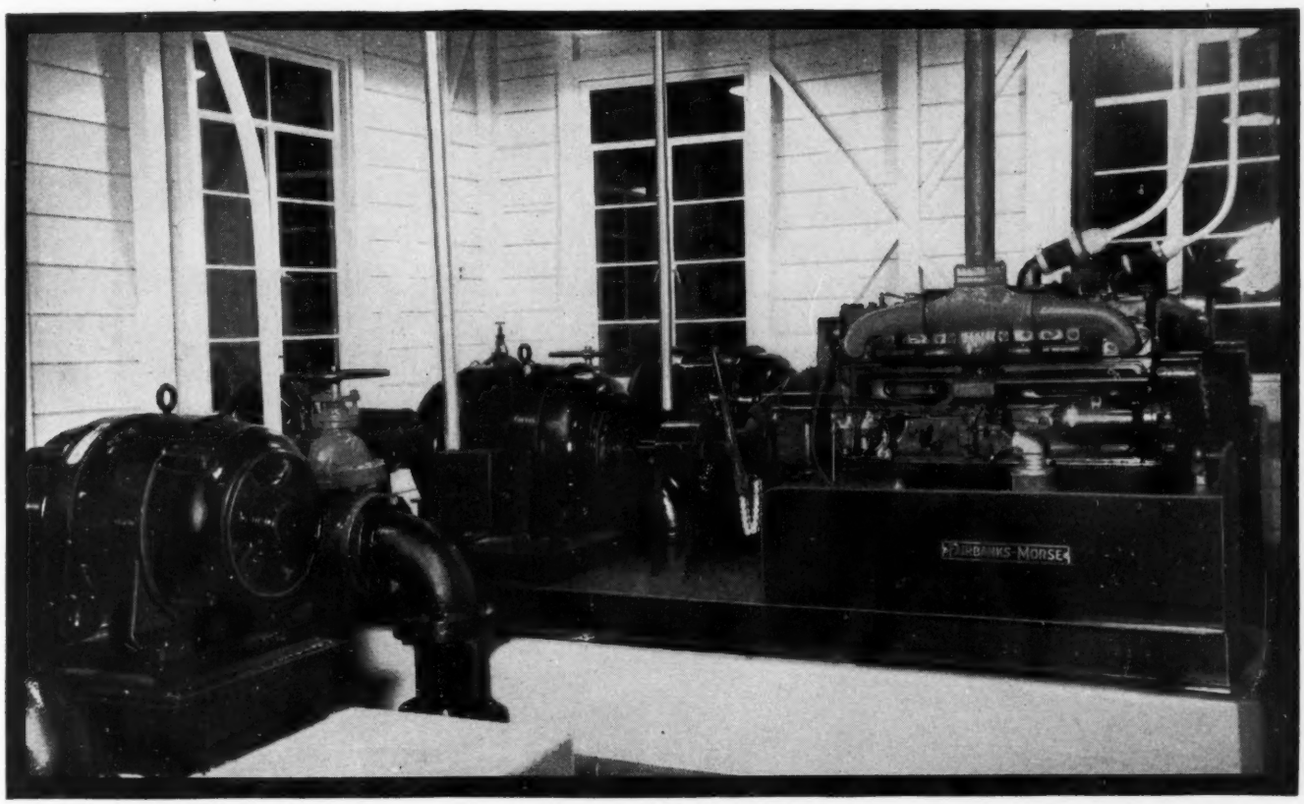
Mountain Water Comes to Pittsburg

and Pittsburg Comes to Fairbanks-Morse

WHEN mountain water flows through the canals built by the government under what is known as the Central Valley Water Project to the Sacramento-San Joaquin Delta, Pittsburg, California is ready to take advantage of it with one of the most modern and efficient pumping plants in the West—100% equipped with Fairbanks-Morse Pumps.

The contract for the pumps in this installation went to Fairbanks-Morse for a very definite reason. On three former occasions when the growing city of Pittsburg was confronted with water supply and pumping problems, Fairbanks-Morse engineers were called into consultation—and Fairbanks-Morse pumping equipment successfully solved the problems.

The experience of Pittsburg's city officials with Fairbanks-Morse engineering co-operation and F-M equipment is a typical case history. Good service and good equipment wins the repeat order when additional equipment is needed. And a repeat order is in itself the best recommendation that anyone can write. If you want this kind of co-operation on your pumping problem, write Fairbanks, Morse & Co., Dept. 115, 600 S. Michigan Ave., Chicago, Ill. Branches and service stations throughout the United States and Canada.



Main pumping plant of Pittsburg, Cal. reservoir to standpipe. Two F-M Fig. 5813 split-case centrifugal pumps direct connected to 30-h.p. motors. In addition, two 5" Fig. 5812 split-case ball-bearing centrifugal pumps are direct connected to 40-h.p. F-M motors and also to two F-M 6-cylinder power units.

7750-PA12.52

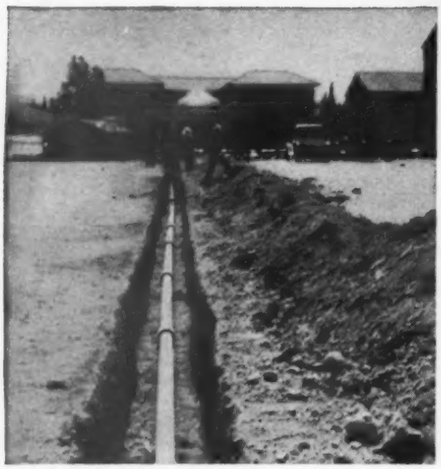
FAIRBANKS-MORSE

DIESEL ENGINES
PUMPS
ELECTRICAL MACHINERY
FAIRBANKS SCALES
RAILROAD EQUIPMENT
WATER-SYSTEMS
WASHERS-IRONERS
FARM EQUIPMENT
STOKERS
AIR CONDITIONERS

F M

Pumps

Here's how J-M TRANSITE PIPE can cut *YOUR* water-line costs—



ARIZONA—Made of asbestos and cement, Transite Pipe cannot tuberculate ... keeps pumping costs permanently low.

MINNESOTA—No large bell holes are needed to install Transite. Trenches are held to minimum widths.

WASHINGTON—Leakage is minimized because Simplex Couplings form tight joints that *stay* tight in service.

In cities, towns, villages alike, waterworks engineers and operators report minimum installation, maintenance and operating costs with this modern water carrier. And here's why . . .

Jobs Are Completed Faster, because Transite Pipe is supplied in long, light, easily handled lengths. Simplex Couplings assure rapid assembly—even when unskilled crews are used. And no large bell holes are needed... trenches can be narrower and more economical.

Upkeep is No Problem, for Transite Pipe is made of asbestos and cement . . . highly resistant to corrosion, immune to electrolysis. Its great durability and uniform strength safely withstand heavy earth loads and traffic pressure. And Simplex Couplings form joints that *stay* tight . . . give maximum assurance against costly water loss.

Tuberculation is Impossible, because Transite is non-metallic. Its initial high flow co-efficient (C=140) can never be reduced by this costly trouble. In many cases, this means that smaller pipe can be used, for it is not necessary to allow for steady decreases in carrying capacity due to tubercle formation.

• • •

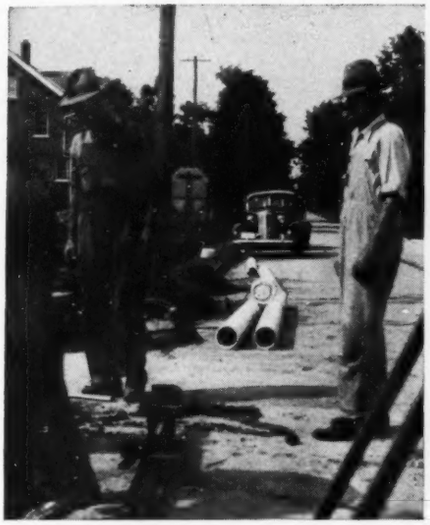
If you haven't checked the advantages of J-M Transite Pipe for use in your community, it will pay you to get all the facts. Write for Transite Water Pipe brochure TR-11A. At the same time, you'll find it worth while to send for Transite Sewer Pipe brochure TR-21A ... and see how Transite Sewer Pipe assures more efficient, economical sewage service. Address Johns-Manville, 22 East 40th Street, New York, N. Y.

JOHNS-MANVILLE JM PRODUCT

Johns-Manville

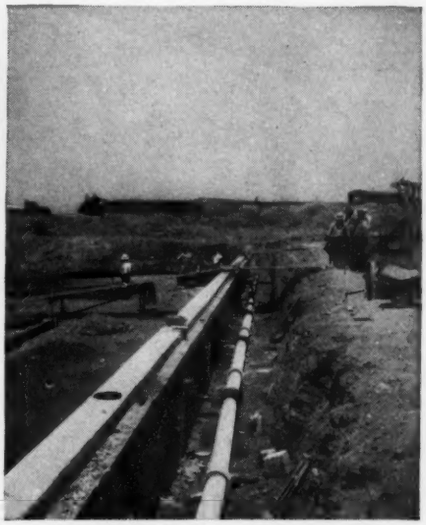
TEXAS—The unusual flexibility of Simplex Couplings permits laying straight lengths of pipe around wide sweeps without the expense of special fittings.

NEVADA—Transite's asbestos-cement composition assures unusual resistance to all forms of corrosion . . . complete immunity to electrolytic action.



WISCONSIN—Transite combines great durability with uniform strength . . . safely withstands heavy earth loads.

SO. CAROLINA—Service connections are quickly made in Transite lines. Tapping is done with standard tools.



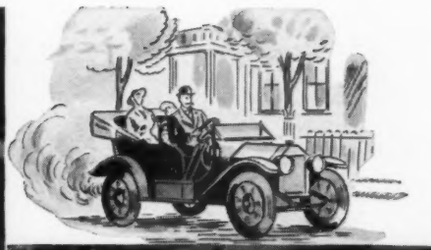
PENNSYLVANIA—Transite's light weight and rapid assembly permit laying pipe as fast as the trench is opened.

WASHINGTON—Flexible Simplex Couplings can be assembled rapidly and economically, even by unskilled crews. A simple hydraulic coupling puller is the only tool required.

MASSACHUSETTS—Hundreds of American communities have reduced water-transportation costs . . . increased operating efficiency . . . with Johns-Manville Transite Pipe.

TRANSITE PIPE

THE MODERN MATERIAL FOR WATER AND SEWER LINES



IN SINCE 1907 -NEVER OUT FOR REPAIRS!

Brackenridge knows the value of Preventive Maintenance

IN 1907, Brackenridge, Pa. needed 40 large iron body valves for its water plant. They would be used in services up to 90 pounds pressure. Some would be subjected to very frequent operation. The community's living depended on these valves, so Brackenridge engineers chose cautiously.

33 years later, Brackenridge points with pride to its judgment. From the day the 40 Crane valves were installed, they have given perfect service. Except for occasional repacking, no repairs of any kind were needed. And indications are the valves will last indefinitely.

It was Preventive Maintenance that Brackenridge applied in 1907. It counseled a choice of valves designed for specific needs: valves which offered greatest resistance to trouble at its source. There lies the secret of low-cost piping.

Today, every water works and sewage plant can fully enjoy the benefits of Preventive Maintenance. The modern Crane line offers valves and fittings exactly suited to every condition of flow control. Whether you need large or small equipment, it's in the great Crane line. Crane engineering, Crane research, and Crane 85-year manufacturing experience assure you of highest adaptability to service.

If you want to keep plant efficiency at a maximum and piping costs at a minimum, Preventive Maintenance will help you. Talk it over with your Crane Representative.

PREVENTIVE MAINTENANCE SAVES TEARING UP STREETS

Repair and replacements of valves in mains and branch lines run into big money. You can save your taxpayers a lot of this cost by choosing valves with extra adaptability to the stress and strain of distribution service. Such valves are Crane No. 480½ double disc gates—conforming to the 1939 A.W.W.A. specifications.

With Crane 480½'s in your streets, you don't have to worry about valve troubles when it is necessary to shut off lines. As you turn the stems, they'll respond smoothly and surely—always.

Learn how you can enjoy greater peace of mind and make important savings in operating costs by applying Preventive Maintenance. Your Crane Representative will gladly show you how it saves where ordinary maintenance wastes.

1940 OUR 85th YEAR

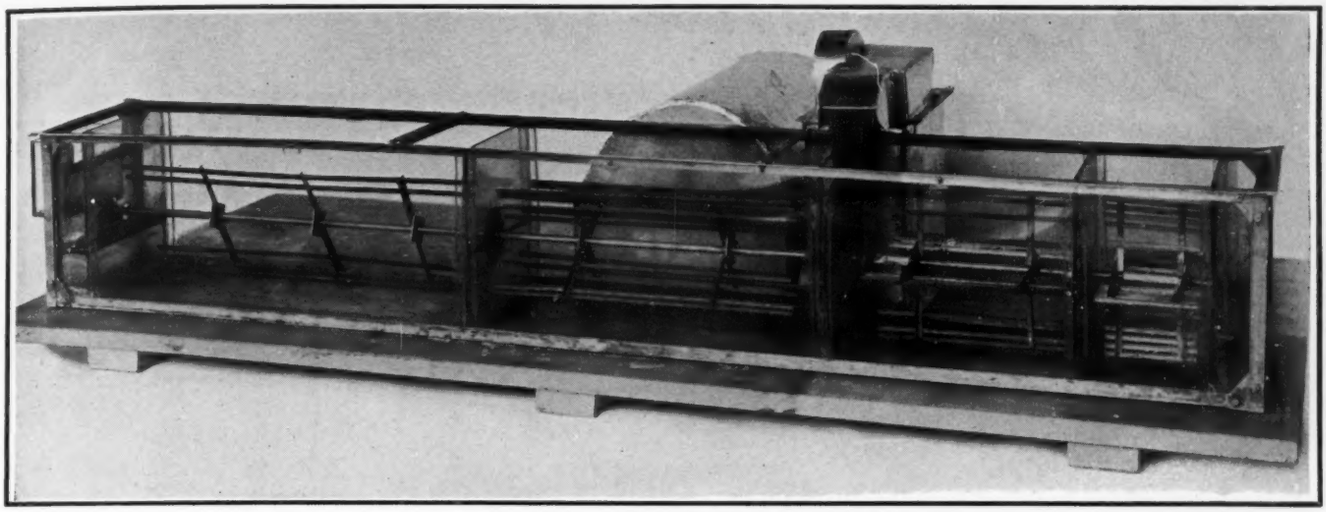
CRANE

CRANE CO., GENERAL OFFICES:
836 S. MICHIGAN AVE., CHICAGO

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

NATION-WIDE SERVICE THROUGH BRANCHES AND WHOLESALERS IN ALL MARKETS

Did You Miss the Demonstration?

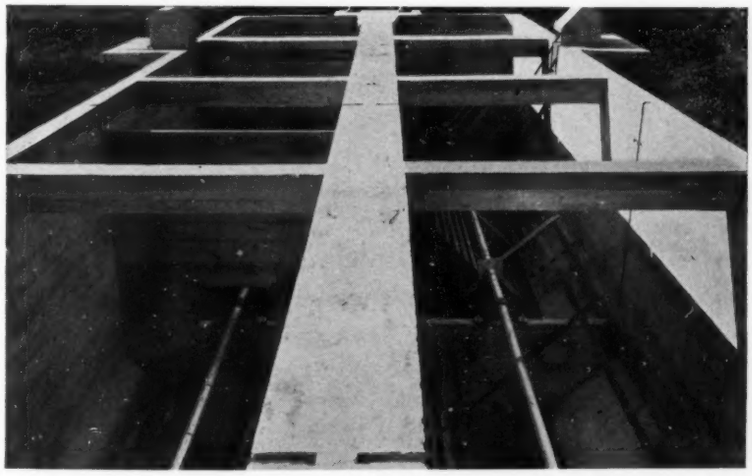


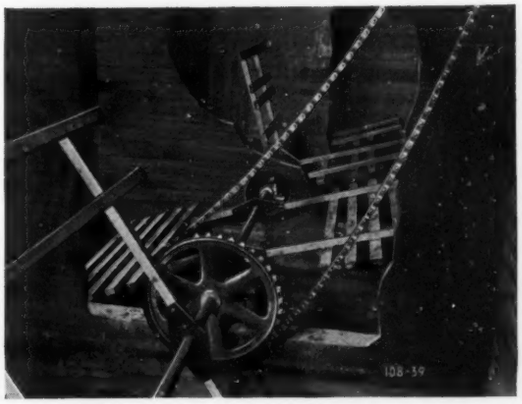
MODEL JEFFREY FLOCTROL (Pat'd & Pats. Pndg.)

Dye tests showing the flow-through characteristics of the Jeffrey Floctrol were conducted during the 1st Annual Convention of the Federation of Sewage Works Association in Chicago early in October.

In the Jeffrey booth was displayed a four-foot Floctrol model scaled from a unit 12 feet square in cross-section and 95 feet long (see above).

With this working model we demonstrated how short-circuiting of liquid can be successfully controlled by proper arrangement of paddle wheels, partitions, baffles, etc.—how the Jeffrey Floctrol retains the liquid under treatment in the zone of action of the paddle wheels.





Close-up of the Jeffrey Floctrol (above) showing the paddle wheels and the partitions, solid except for openings at the axis of the shaft. In view left, the arrangement of paddles for varying rates of agitation is shown in right-hand tank. In the left-hand tank are shown the divisions made by wooden baffles, with ports at center.

We have just issued a new Bulletin covering the Jeffrey Floctrol in detail with charts, drawings and pictures. Send for your copy NOW.

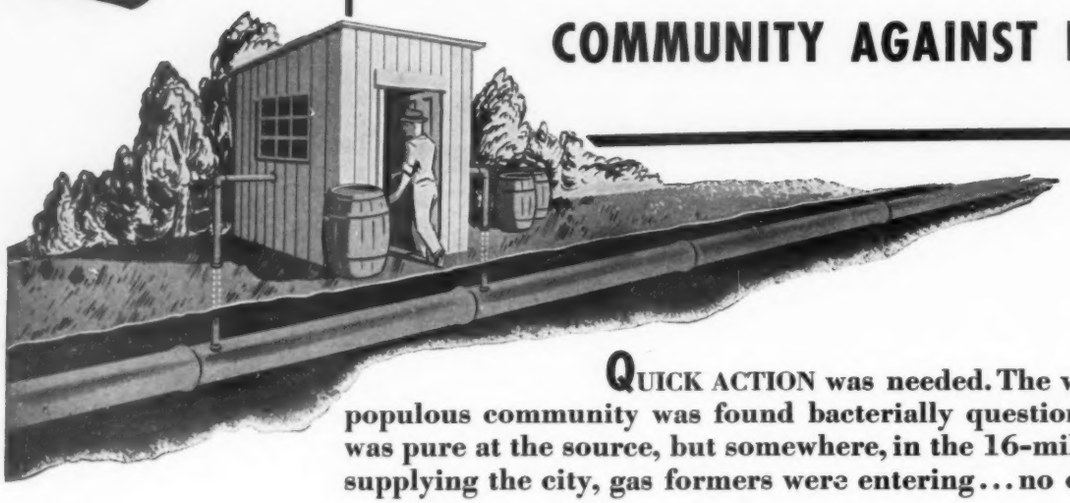
Sanitary Engineering Division

The Jeffrey Manufacturing Company

996-99 North Fourth Street, Columbus, Ohio

Quick Treatment

WITH PERCHLORON PROTECTED THIS COMMUNITY AGAINST DANGER



QUICK ACTION was needed. The water supply of a populous community was found bacterially questionable. The water was pure at the source, but somewhere, in the 16-mile pressure main supplying the city, gas formers were entering... no one knew where.

The time required for a systematic search would leave the community unprotected too long. The supply had to be sanitized immediately without waiting for special chlorinating equipment.

Perchloron made quick, effective action possible with the greatest ease. Two taps in the pressure main near the water source were connected by means of piping and a small electric pump, and Perchloron solution was fed steadily into the suction of the pump. The quantity added was sufficient to attain a residual of 0.3 p.p.m. chlorine after 20 minutes' contact. The long length of the main provided the desired contact.

By this means the gas formers were eliminated. The community was assured of a safe water supply until the source of the pollution could be discovered and the trouble corrected.

This is but one example of the way in which Perchloron fits in. It is used for sanitizing new mains, for clear wells and filters, and for swimming pool sanitation. It is your easily adaptable emergency supply of chlorine. It is a dry, free-flowing granular material containing more than 70% available chlorine. Ready-to-use solutions are quickly prepared by dissolving Perchloron in tap water.

Perchloron is stable, concentrated, uniform. Packed 9 handy-sized cans to the case, each can with Kork-N-Seal cover. Also in 75-lb. drums. Write for free, illustrated booklet. Pennsylvania Salt Mfg. Co., Widener Bldg., Phila., Pa.—New York • Chicago • St. Louis • Pittsburgh • Tacoma • Wyandotte.

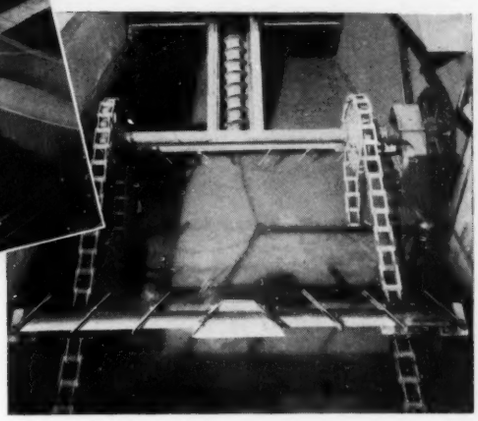
Perchloron

PENNSYLVANIA SALT MANUFACTURING COMPANY

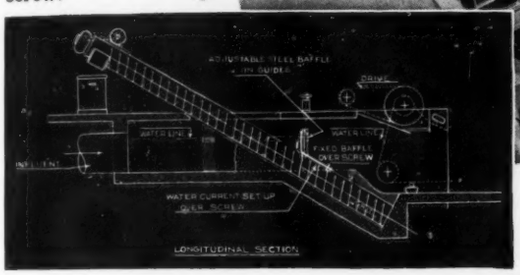
Chemicals

General view of Joint Meeting Treatment Plant at Elizabeth, N. J. Link-Belt STRAIGHTLINE Grit Collectors and Washers in the foreground.

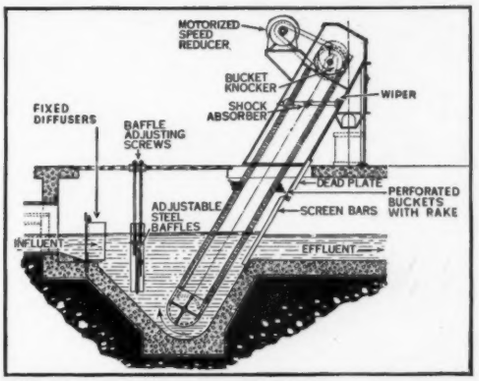
Close-up of Link-Belt STRAIGHTLINE Grit Collector. Note flights set at an angle with direction of travel, which keep settled grit continually turning over, freeing lighter particles of organic matter.



Section of Link-Belt STRAIGHTLINE Grit Collector and Washer showing washing and dewatering screw.



"HERE'S HOW TO Hit the Grit"



Link-Belt TRITOR Screen, which combines the functions of a mechanically-cleaned bar screen and grit chamber.

● Remove grit at the earliest possible stage in the treatment of sewage, or it will cause trouble all along the line—in excessive wear of pumps, clogging of valves and siphons, etc. Link-Belt, drawing on extensive experience, recommends the TRITOR, which is a combination of screen and grit chamber, for small and medium size plants, and the STRAIGHTLINE Grit Collector and Washer for larger plants. This latter unit removes grit and similar detritus from the chamber and discharges with a minimum of organic material and moisture.

Because it is designed and constructed to keep operating costs at a minimum, with efficiency and flexibility to meet varying conditions, Link-Belt equipment is preferred by many progressive communities everywhere.

WRITE FOR THIS *Literature*

Folder No. 1942 covering the STRAIGHLINE Grit Collector and Washer, and Folder No. 1587 on the STRAIGHTLINE Bar Screen, and TRITOR Screen and Grit Chamber.

LINK-BELT WATER and SEWAGE TREATMENT PLANT EQUIPMENT INCLUDES: STRAIGHTLINE Mechanically Cleaned Bar Screens, Tritor Screens, STRAIGHTLINE Grit Collectors and Washers, Elevated Diffusers, STRAIGHTLINE and CIRCULINE Sludge Collectors for Primary and Secondary Tanks, Bio-Filtration System for Treating Sewage, STRAIGHTLINE Mixers for Flocculation Tanks, STRAIGHTLINE Scum Breakers for Digestion Tanks, Traveling Water-Intake Screens, Industrial Waste Screens, Roto-Louvre Dryers for sludge and other wet materials, P.I.V. Gear Variable Speed Drive for Pumps, and a complete line of elevating, conveying and power transmitting equipment.

LINK-BELT COMPANY

Specialists in the Manufacture of Equipment for Water and Sewage Treatment Plants

PHILADELPHIA	CHICAGO	LOS ANGELES	CLEVELAND
2045 W. Hunting Park Ave.	300 W. Pershing Road	361 S. Anderson St.	548 Rockefeller Bldg.

Atlanta . . Baltimore . . Boston . . Buffalo . . Dallas . . Denver . . Detroit . . Grand Rapids . . Houston . . Huntington, W. Va. . . Indianapolis . . Kansas City, Mo. Louisville . . New Orleans . . New York . . Oakland, Calif. . . Pittsburgh . . Portland, Ore. . . Salt Lake City . . Seattle . . St. Louis . . St. Paul . . Wilkes-Barre

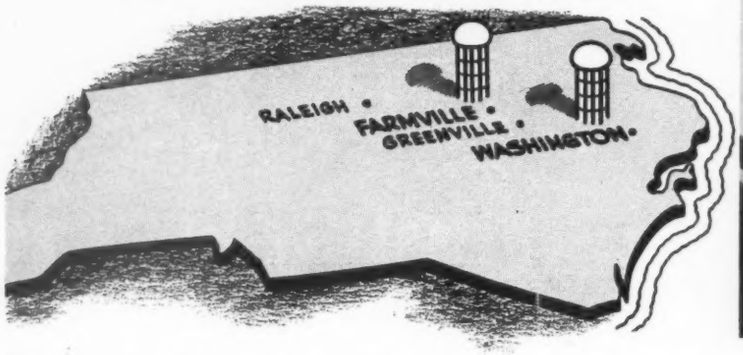
In Canada—Link-Belt Limited—Toronto Plant; Montreal; Vancouver; Swastika

8384

LINK-BELT

SCREENS · COLLECTORS · AERATORS · GRIT CHAMBERS · MIXERS

2 More ELEVATED WATER TANKS



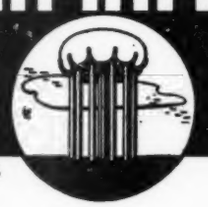
For North Carolina municipalities . . . .

The 300,000-gal. Horton tank at the upper right is installed at Farmville, N. C. Directly above is a unit of identical capacity at Washington, N. C. The map shows the general location of these municipalities with respect to surrounding cities.

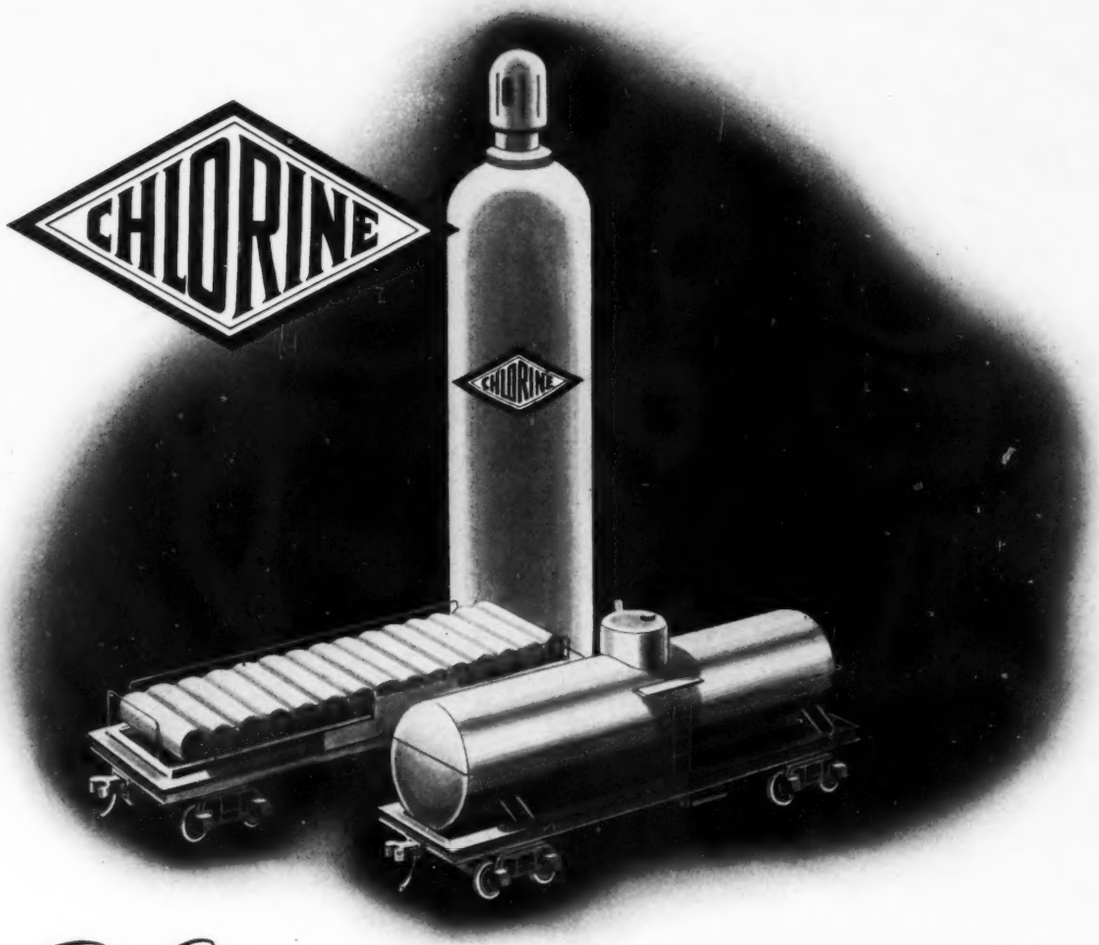
WASHINGTON and Farmville now join the ever-increasing list of towns and cities throughout the State of North Carolina that have installed modern elevated storage tanks. In these two municipalities of 8,500 and 3,000 population, respectively, individuals responsible for the provision of water supply facilities are making sure that municipal and industrial water consumers will enjoy improved service, more uniform distribution pressures, and greater protection against fire hazard by installing elevated storage tanks of adequate capacity to handle present and future requirements. Let us show you how advantageously elevated storage will fit into your water works program. Call or write our nearest office for information or estimating data. No obligation, of course, for this service.

CHICAGO BRIDGE & IRON COMPANY

Chicago	2198 McCormick Bldg.	Birmingham	1586 North 50th Street	Philadelphia	1644-1700 Walnut St.
New York	3390-165 Broadway Bldg.	Tulsa	1646 Hunt Bldg.	Boston	1548 Consolidated Gas Bldg.
Cleveland	2262 Rockefeller Bldg.	Houston	918 Richmond Avenue	San Francisco	1083 Rialto Bldg.
Dallas	1679 Praetorian Bldg.	Detroit	1551 Lafayette Bldg.	Los Angeles	1455 Wm. Fox Bldg.



Plants at **BIRMINGHAM, CHICAGO, and GREENVILLE, PA.** *In Canada:* **HORTON STEEL WORKS, LIMITED, FORT ERIE, ONT.**



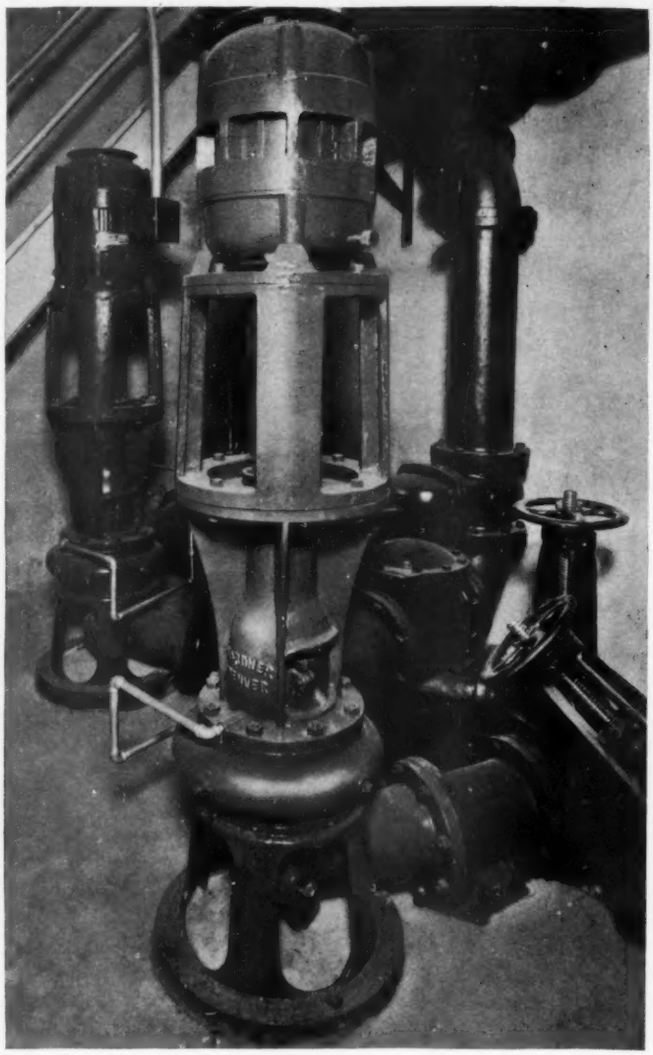
Regardless OF HOW YOU USE

DIAMOND LIQUID CHLORINE

DIAMOND ALWAYS COMBINES UNIFORM PURITY WITH MAXIMUM SAFETY AND CONVENIENCE IN HANDLING

DIAMOND plays no favorites! The one-cylinder user can count on the same uniformly pure, safely delivered Liquid Chlorine as can the largest tank car user! Years of sympathetic study of YOUR problems have evolved a technique in packaging, shipping and handling Diamond Liquid Chlorine that insures safe delivery in the type of container most convenient for your use.

DIAMOND ALKALI COMPANY • PITTSBURGH, PA., AND EVERYWHERE



A city in upper New York recently installed these type "K" pumps, convinced that they would produce substantial savings. Each pump has a capacity of 700 gallons per minute, pumping against a total head of 40 feet at 1150 revolutions per minute. The pumps pictured above are powered by 10 horsepower, 3 phase, 60 cycle electric motors.

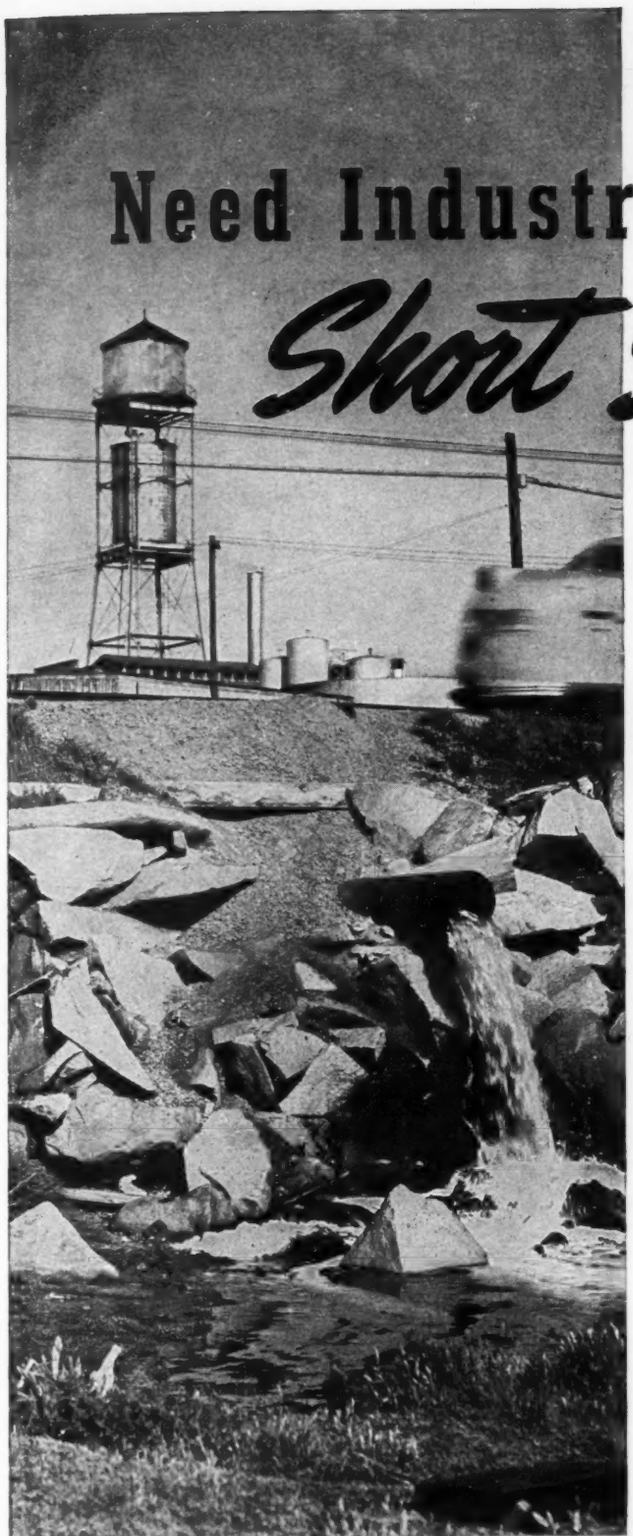
"I CALL that *real* performance! Notice that in every month since we replaced our old pumps with the Gardner-Denver type "K" sewage pumps, we have had reductions in our power costs. What a difference real efficiency makes!"

This is what managers of water works are saying about this vertical sewage pump. They know that efficiency is extremely important when pumps are in constant use. Even a slight increase will mean large reductions in operating costs. They know that every feature of the Gardner-Denver type "K" pumps is designed to give this efficiency.

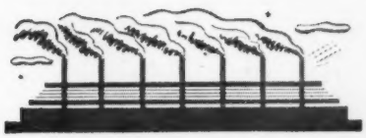
MEMBER HYDRAULIC INSTITUTE U.S.A.

A letter to us at Quincy, Illinois, will bring you a bulletin on these economical pumps. It will explain in detail all the features which make it possible for Gardner-Denver to give maximum performance at minimum cost.

GARDNER-DENVER SINCE 1859



Need Industrial Waste Cause *Short Sewer Life?*



Installed under a main line railroad near the seacoast, this ARMCO Asbestos-Bonded Pipe discharges corrosive waste from a large industrial plant. A stern test of material durability and structural strength.

It's true that sewer materials often fail quickly when handling industrial wastes. Yet there *is* a way to extend sewer life under these conditions. A special bituminous coating has proved excellent protection against corrosion. The only problem was how to obtain positive adhesion between coating and sewer.

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L. H. Enslow, Editor

COMING!

"Developments and Trends in Water Supply and Purification Practices"

Constitutes the annual review of progress in water supply to be featured in our January 1941 issue. We have been very fortunate in securing as author of the 1940 review one of the most capable and well equipped reviewers in the field—

NORMAN J. HOWARD of Toronto,
President of A. W. W. A.

"Developments and Trends in Sewerage Practices and the Treatment of Sewage and Industrial Wastes"

Constitutes the annual review of progress in sewerage and sewage disposal, which is to be featured in our February 1941 issue. Again we have been most fortunate in the reviewer who is Chairman of the National Water Resources Committee, and a writer extraordinary who needs no further introduction than to say he is—

DR. ABEL WOLMAN,
Professor of Sanitary Engineering,
Johns Hopkins University.

"Youth Studies Water Supply and Sewage Disposal"

Two interesting articles reveal what the members of a National organization, comprising the younger generation, learned upon "looking in" on the water supply and sewage disposal facilities of their respective communities. The "Camp Fire Girls" organization has encouraged its member groups to make a study of their local municipal utilities. As a result, their impressions, and recommendations for improvement (and this is the interesting feature of these reports) have been prepared for publication in WATER WORKS & SEWERAGE. This movement to get the on-coming citizens interested in their public utilities has meritorious significance, and their impressions make interesting reading.

"Some Experiences and Results in Plant Lighting"

Comes from those responsible for the lighting arrangements of the new Milwaukee Filter Plant which can, we believe, boast the most effective lighting system of any plant we know. The author—

ARTHUR RYNDERS, Electrical Engineer,
Dep't of Public Works, Milwaukee, Wis.

"A Quick Simple Method of Determining Solids in Sewage Sludges"

Is that developed at the Buffalo Sewage Treatment Works and should be a marked help to operators wishing to quickly determine, with a fair degree of accuracy, the solids content of sludges. The scheme involves centrifuging samples and applying a factor to convert % solids by volume to % solids by weight. The author—

DR. GEO. E. SYMONS, Chief Chemist,
Buffalo Sewage Authority, Buffalo, N. Y.

"On Starting a New Sewage Treatment Plant"

Constitutes a compilation of worthy suggestions to those who have had no experience in starting up a new treatment plant. Neither had the author, and this is what led him to undertake an article which takes on the nature of a guide. The author—

BERNARD ROWNTREE, Manager,
The Sanitary District of Carmel, Calif.

"Thawing Mains and Service Lines"

Comes from a plant manager of considerable experience who discusses basic considerations and outlines practical procedures in main and service line thawing by electrical methods. In brief, the contribution constitutes a "Guide in Electrical Thawing" comprising useful data, recommended procedures, and suggested precautions to consider. The author—

FRANK C. AMSBARY, Jr., Manager,
Illinois Water Service Co., Champaign, Ill.

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WATER WORKS & SEWERAGE

VOL. 87, NO. 12 *A Gillette Publication* DECEMBER, 1940

LIME AND LIME SLAKING

By H. E. LORDLEY
Plant Manager, Department of Public Utilities
RICHMOND, VA.

LIME is one of the oldest chemcals known to civilization, yet today the efficient utilization of this important chemical is impeded by lack of complete information concerning its physical and chemical properties. Since lime is used in such large quantities for softening and corrosion control in the water works field, it is amazing that so little information is to be found in water works literature on the subject of lime and lime slaking.

The Author

There Is Lime and Lime

Limestone, which is the source of the calcium oxide, will vary in physical and chemical properties in different parts of the country. Some limestone is high in magnesium which is objectionable for use in water purification plants, yet suitable for other chemical processes. Other sources are high in iron and silica, so it is well to study an analysis of the raw stone before buying lime for the water plant. At the lime plant, in the first step of processing the rock for calcining, a superior finished product results if mud, sand, and other impurities are removed before burning. In the actual calcining step, the manufacturer can control both the physical and chemical properties of the lime, either by the type of kiln or the method of firing. Therefore, we get much lime that is either underburned or over-burned by lack of control of the process at the kiln.

Take, for example, the old style vertical kiln using coal as a source of heat without modern control equipment, we find that the lime thus burned will slake very slowly. On the other hand, the modern controlled rotary kiln produces lime that will slake so rapidly that it actually explodes in the slaker. The author recalls an amusing incident at the Richmond Filter Plant on changing from a vertical kiln to a rotary kiln lime. The operator frantically called to report that the lime slaker was out of order and making a terrible rumble in the slaking chamber. On investigation, the new rotary kiln lime was producing miniature explosions that sounded like a loose agitator blade. Also common to the old style vertical kiln is the large percentage of core as compared to practically core-free lime from the rotary kiln. So we see that all lime is not the same from every lime plant and the water works executive must choose the source of lime carefully if highest efficiency is to result.

As to Lime Properties

After the lime leaves the kiln it must be graded as to size. Quicklime can be furnished in sizes varying from a fine pulverized product, which will pass a 200 mesh screen, to a pebble lime of two inch size. In determining the proper size to use in the plant, the operator must remember that the pulverized lime offers both a dust problem and a feeding problem due to arching in the hopper. Dust can be controlled by proper ventilating system, but arching is just a universal worry. Arching can be partly corrected by design of light weight hoppers having a bottom slope of not less than 60° from the horizontal. "Syntron" vibrators on the side of the hopper will further reduce arching, but the best answer is the use of pebble lime of size from ¼ inch to ¾ inch, provided suitable feeding and slaking equipment is available. Dust is reduced, arching in hoppers is eliminated, and air-slaking of lime in storage is not as rapid with pebble lime as with the pulverized lime. Another physical property of interest is the color of the lime; white, gray, black, blue, etc. All are high in calcium oxide, and color is not a criterion of a good lime. The chemical properties and specifications are easy to determine in the laboratory. The lime should contain not less than 90 percent CaO, have a low magnesia, silica, and iron content, and be free of arsenic.

In many plants today, calcium hydroxide (hydrated lime) is preferred to calcium oxide, due largely to lack of information and equipment for slaking the oxide. The lime manufacturer is anxious to dispose of calcium hydroxide, since all fines from calcium oxide are converted into calcium hydroxide at the lime plant. The water works executive must remember that he pays for the slaking process plus freight on water in hauling hydrated lime in preference to burned lime.

The Omega Lime Feeder and Slaker

Beneath the feeder is the agitated slaking vat with thermostatic control. The swirl pot on the left is the vapor condenser and dust scrubber. The water meter and pressure reducing valve are visible. Inside of the cabinet is the volume regulating needle valve.

Behind the Cabinet Doors

The motor drives the cam that oscillates the feed tray. The automatic feed control wedge of live rubber hangs on the wire in the center of the picture. The feed setting knob is located to the left of the thermometer indicating the temperature of the input slaking water from the heaters. Water control valves appear on the right.

Economic Considerations

Table I

	Typical Calcium Oxide Lime	Typical Calcium Hydroxide Lime
Insoluble Residue ..	1.57	.37
R_2O_3	.48	.52
Loss on Ignition...	1.34	2.19
Magnesium oxide ..	1.26	.50
Calcium oxide	95.33	92.00*
CaO Equivalents ..	96.59	70.00
Cost Price Del./Ton	$11.00	$10.00
Cost Price per CaO/Ton	$11.38	$14.28

*Calcium Hydroxide—$Ca(OH)_2$ or $CaO+H_2O$.

In Table No. 1, a typical analysis and price of calcium hydroxide as compared to calcium oxide shows the economic status of the two types of lime. In buying a typical pebble calcium oxide in place of calcium hydroxide, a net saving of $2.90 per ton of CaO equivalents is realized, plus higher operating efficiency. In actual plant operation the saving will be greater, since the theoretical ratio of one part CaO to 1.32 parts $Ca(OH)_2$ approaches a practical operating ratio of 1 part CaO to 1.5 parts $Ca(OH)_2$.

Another way to save money in buying quicklime, is in the size of the lime. A pulverized calcium oxide (passing 200 mesh) is more costly than a standard pebble or cracked lime. The manufacturer must charge for the expensive process of pulverizing and will raise the price of calcium oxide from $11.00/ton to approximately $13.00/ton for the pulverized product. Also for large plants, the lime shipped in 15 ton cars cost more than in 25 ton cars, due to the freight rates.

With the money that can be saved by shifting from calcium hydroxide to pebble calcium oxide, an excellent feeder and slaker can be purchased and the lime treatment will become a controlled process rather than the usual "hit or miss" process. The operator should investigate and experiment with different types of lime to find the one best suited to his own plant and local conditions.

Lime Slaking Equipment and Its Operation

The operation of the slaker is not easy. Like a man learning to ride a bicycle, the problem looks simple yet requires initial research and a few hard knocks before the art is mastered.

First, and most essential, is an efficient dry-feeder. In the Richmond Filter Plant, an OMEGA lime feeder delivers the lime to the slak-

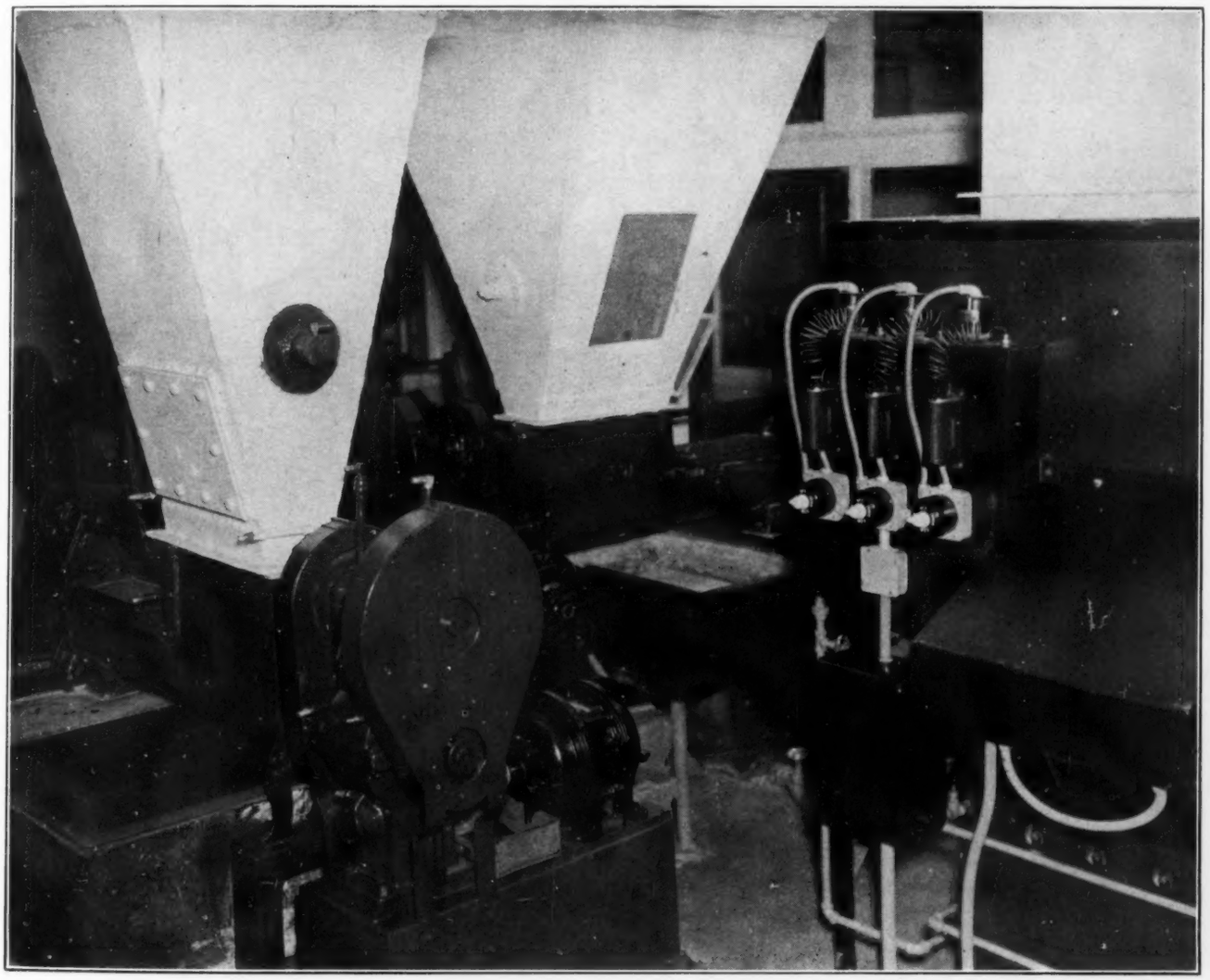
ing vat at an astoundingly accurate rate. The feeder is a gravimetric batch type having a maximum capacity of 175 pound/hour and a minimum capacity of 1.75-pound/hour. The feeder has a 1,000 pound capacity, and properly designed hopper equipped with an agitator and mounted on a sensitive beam scale. The adjusting mechanism for changing the rate of feed is located in a compact unit with an alarm to indicate any trouble in feeding, such as an empty hopper or failure of material to leave the hopper. The lime feed is controlled by the vibrating plate at the bottom of the hopper. The pebble lime of size not exceeding ¾ inch size falls off the vibrating plate directly into a compact Omega Slaker located on the same floor with the feeder in a floor space of only 54 inch by 84 inch for both feeder and slaker. The unit is equipped with a water operated vapor removal system to collect dust and steam from the slaker. The water from this unit is not wasted, but is used as make-up water for the slaker or in conveying the lime to the point of application. The slaker has a minimum retention period of 30 minutes at the maximum rate of feed and is agitated with a motor driven impeller so adjusted to give proper circulation in the chamber.

Temperature Control Important

The optimum temperature for slaking will vary both with the type of lime and the retention period in the slaker. The most efficient slaker temperature range is between 150° F. and 180° F.; above 180° F. the steam and vapor will overload the vapor removal equipment and cause corrosion of the slaker and feeder. In the Richmond plant, the optimum temperature is 160° F. using a pebble lime having a 96 per cent CaO content. In order to maintain this temperature in the shaker, with our incoming water varying between 33° F. and 85° F., an electric water heater of three No. M-240, 4000 watt Chronolox immersion heaters was purchased for the job. The heaters are equipped with three-way switches for seasonal control and thermostats on each unit to supply make-up water at a uniform temperature regardless of the temperature of the incoming water. The heat of hydration of calcium oxide is 273 calories per gram. However, in slaking small quantities of lime some of this heat is lost and must be supplemented by heat from the make-up water.

Proper Water Ratio

In slaking lime, too little water gives a heavy slurry that is too thick to be agitated properly by the im-



Part of the Chemical Feeder Room

On the right is seen the three unit electric water heater on the rear of the lime machine to insure a constant temperature slaking water. Beneath the hood is the slaker agitator motor. (The feeder in the left foreground is used continuously for activated carbon—and, believe it or not, it remains white. Evidence sufficient that dust control has been pretty thoroughly perfected at Richmond.—ED.)

Lid Raised on Outflow End of Slaker

Note vapor and dust scrubber on left; water meter and reducing valve on right.

peller, yet an excess of water increases the expense of heating make-up water and will dilute the lime so that maximum retention time in the slaker is materially reduced. Different brands of lime require variable quantities of water, but a slurry of the proper viscosity is usually obtained by a ratio range of 1 pound lime to 3 pounds water to a ratio of 1:4½. After a series of experiments at the Richmond plant, the ratio of 1:4 was adopted and gives excellent operating results.

To control the ratio, a standard water meter is connected in the supply line to the heater. The meter was geared so that the lowest dial actually reads 3 times the amount of water passing through the meter. For example, one cubic foot of water passing through the meter indicated three cubic feet on the dial. This method was devised to afford the operator a chance to check the water flow at low rates much more readily than with the regular meter dial. After checking the flow, the operator refers to a chart (see Table 2) showing the meter reading corresponding to each rate of lime feed for a ratio of 1:4, adjustment being made by the needle control valve if necessary. Example: Feed 50 lbs./hr. of lime. Requires for ratio 1:4, 50x4 or 200 lbs./hr. of water equals $\frac{200}{62.4} = 3.2$ cu. ft. per hour of water. On special dial, this reads 3.2x3 or 9.6. On the chart opposite the rate of 50 lbs./hr. is the value 9.6 which should be the reading of the meter for one hour. The operator adjusts the valve to get this reading.

The lime after slaking is diluted with water from the vapor removal unit and flows over a weir into the outlet line. Some lime has considerable core so that the machine is designed for core removal, without stopping the slaker operation. The core is removed to a chamber to be washed to recover any calcium hydroxide on the surface and is then dumped into a trash can under the slaker. Tests are being run on the amount of unslaked lime in the sample collected at the effluent of the slaker but are not complete enough at present to report in this paper.

Piping Lime Suspensions

No other problem seems more perplexing than that of transporting the lime to the point of application 300 feet or 400 feet from the slaker. If duplicate lines are available, one line can be cleaned with a chlorine solution while the other line is in service. However, caution must be observed to prevent the chlorine from actually attacking the iron pipe. Recently suggested is the use of "Calgon" to keep the lines free of incrustants but so far little work has been reported on this method. Many plants use rubber hose and clean the line by beating or shaking the hose. The author has found that the open trough is the simplest method of delivering the lime, brovided the necessary fall between the machine and point of application can be obtained.

Table II

Water Meter Reading vs. Dial Setting for Optimum Ratio one lime to four water

Pounds/hr. Lime	Dial Setting	Meter Reading (Cu. ft.*)
1.75	1	.3
8.75	5	1.6
17.50	10	3.4
26.25	15	5.0
35.00	20	6.7
43.75	25	8.4
52.50	30	10.0
61.25	35	11.7
70.00	40	13.5
78.75	45	15.1
87.50	50	16.7
96.25	55	18.4

*Special Meter Dial. Indicates three times actual flow.

pH Control Simplified

So accurate is the control of pH with the new Omega slaker that in the Richmond plant we can hold a constant pH of 8.7 in our finished water. It is important to note in Table No. 3 that prior to the installation of the slaker, we had trouble in our distribution system with a decided drop in pH. Now with the present slaker we have only a slight drop and a corresponding decrease of iron in the dead-ends. We can only explain this by the fact that the controlled slaking is productive of a more highly peptized lime suspension—more nearly a colloidal suspension.

Table III

Station No. 34*

Location—Broad Rock Road

	Before Slaker Installation 1938	After Slaker Installation 1940
Res. Cl_2	.00	.00
Turb.	6.0	.80
Color	40	10
Alk. (M.)	23	36
Alk. (Phen.)	0	4.5
CO_2	0	0
pH	8.1	8.6
Fe_2O_3	4.0	.40

*This station is located near a dead-end.

It is hoped that water works men will study lime treatment and get more lime per dollar. Remember that often obsolete equipment can be scrapped and new equipment purchased with the saving, so why not have a modern plant at no extra cost?

FOUR STATES SECTION HANGS UP "S.R.O." SIGN

Lloyd Nelson Drafted as New Secretary; "Wheel Horse" Hechmer Rewarded with Vice-Chairmanship.

THE Four States Section of A. W. W. A. has not in many years held such a successful meeting as that staged on November 7th and 8th at Hotel Du Pont in Wilmington, Del.

With the boosted attendance resulting from the policy of inviting the Pennsylvania Water Operators Association to hold its fall meeting jointly with the Section, the official registration ran up to 174.

Without much question the excellence of the technical program was in no little measure responsible for the swollen attendance and, more particularly, for the need of hanging up an "S. R. O." sign outside of the meeting room door.

Concerning the technical program and local arrangements, Secretary Jordan of A. W. W. A., in commenting on the strides made by the Section under Secretary Carl Hechmer, took an especial pleasure in complimenting the Chairman of the Program Committee—L. L. Hedgepeth, Manager, Technical Service Department, Pennsylvania Salt Mfg. Co.—and W. C. Wills, Manager of the Wilmington Water Department, as Chairman of Committee on Arrangements, for their parts in making the 1940 meeting so successful and pleasing. As Mr. Jordan very factually put it, such interesting programs and successful meetings do not just happen, but are invariably the result of intelligent planning and hard work on the part of those responsible. Whereupon the Chair called Messrs. Hedgepeth and Wills to their feet to receive a round of applause from the 150 banqueteers.

"Get-Together" Party

On the evening before the official opening of the meeting, the "Get-Together" Party, staged in the club room of Hotel Du Pont, proved a successful means of getting early comers together to rub elbows, partake of light refreshments (on the Section), play bridge, argue election results, and indulge in just plain old-fashioned shop-talk. Everybody got an opportunity to meet everybody else. It seemed an excellent scheme, worthy of note by other A. W. W. A. sections and associations.

Chairmen

(Retiring)
I. M. Glace, Consulting Engr., Harrisburg, Pa.

(Incoming)
Edw. S. Hopkins, Filtration Engr., Baltimore, Md.

The Banquet

At the Annual Banquet, Toronto's Norman J. Howard, President of A. W. W. A., briefly reviewed the work of the Association and then by request recounted what Canada is doing in its war activities and in support of the British efforts across the sea. Amongst the many things named, "N. J." placed emphasis on

Secretaries

Carl A. Hechmer, Div. Engr., Washington Suburban San. Distr. (Elected Vice-Chairman of the Section.)

Lloyd Nelson, Eastern Sales Mgr., U. S. Pipe and Foundry Company (An old hand at the game and past A.W.W.A. Director is drafted.)

the thousands of Canadian air-pilots being trained for overseas duty, and also cited some rather impressive statistics regarding the boosted production of Canadian plants turning out war materials and other supplies most needed by the Mother Nation.

W. W. Brush, Treasurer of A. W. W. A., in his scheduled talk, spoke concerning recent acts that have been introduced in both houses of Congress which, if passed, will extend the Social Security Act to include state and municipal employees. It is understood that these bills will in no wise interfere with existing or future pension systems—at least not those under which municipal employees may benefit to a greater degree than through the Social Security Plan of the Federal Government.

The scheduled talk by Abel Wolman, now serving as A. W. W. A. Director and the former Editor of the Journal, was not given due to the fact that he was unexpectedly called away from the meeting.

The principal speaker of the evening was Du Pont's Dr. James K. Hunt, who presented a highly interesting picture by word, by display, and movie film in technicolor of "A New World Through Chemistry." The picture portrayed and explained the discovery and commercial development of the new and astounding Du Pont products, "Nylon," "Lucite" and "Neaprene," the remarkable synthetic rubber with qualities surpassing natural rubber.

Something of a surprise feature was the modeling of the first dinner gown made wholly of "Nylon" lace. With something of a keen eye, "Doc" Hunt had persuaded Miss Connie Glace (daughter of the Chairman) to model this "exquisite creation," which she did to perfection. And, may we say, that most of us haven't yet been able to decide which was the more exquisite—the lace or the lass. The combination, we do know, was not short of gorgeous.

The Chairman Has Twice to Blush

As though the Chairman's one blush (the lace and lass episode) was not enough, he was forced to do so a second time in about as many minutes, for it was shortly announced by Chas. P. Abraham (Lancaster, Pa.), Chairman of the Committee on the Fuller Award, that after due consideration, I. M. Glace had been chosen to receive the George W. Fuller Award for 1940. Mr. Glace was cited for his work in the Pennsylvania Water Operators Association and in the Four States Section in bettering the qualifications and status of water works operators—those in his home state in particular.

(And what do you suppose Harry Krum, arch golf-enemy of Glace's, had to say about the award? He said, "It's just another Glace frame-up—that's all!" —Ed.)

Plant Inspections

On the afternoon of the first day, Wilmington's old original but still operating slow-sand filter plant was visited, as also was the new rapid sand plant. Thereafter was visited the Hoopes Dam, creating the reserve and emergency raw water storage reservoir and pumping station of the Wilmington System. This project completed only a few years ago, is described in an article by Chief Engineer W. Compton Wills, in *"W .W. & S."* for January, 1933. The unique feature is that water from Brandywine River is pumped into the reservoir during flush river flow periods for use if needed during depleted flow of the regular supply, or should pollution by trade wastes warrant

Dr. Abel Wolman, Johns Hopkins Univ.
(A.W.W.A. Director)

L. L. Hedgepeth, Penna. Salt Co.
(Program Chairman)

drawing on the stored supply temporarily. The pumping facilities at the reservoir, needed to boost the water to the slow sand plant, comprises 100 per cent gasoline driven centrifugals in order that power company standby charges be eliminated at a very material saving on this occasional use pumping station. Less expensive overall, in this instance, is adaptation of the gasoline engine over the more expensive Diesel, with its materially lower operating cost.

1940 Short School a Success

Carl Hechmer, Secretary of the Section, has been in charge of arrangements for the short schools held at the University of Maryland under joint sponsorship of the Four States Section, the Maryland-Delaware Water and Sewage Works Ass'n., and the Maryland State Dept. of Health. He reported a successful 1940 School attended by 60, and stated that the next school will be held in 1942, the Committee on the Short School having decided that a Bi-Annual School is the most practical and best attended.

New Officers

With a great deal of regret members of the Four States Section heard Carl Hechmer explain why it had become necessary for him to relinquish

Roberts Hulbert, Detroit, Mich. (Co-developer of high-rate filter wash.)

Carl B. Brown, Washington, D. C. (His work on reservoir silting a real contribution.)

the very demanding office of Secretary-Treasurer of the Section. In searching about for a member to take over the post and carry forward the stimulating work of Mr. Hechmer, a man with a record of having performed a splendid job as secretary of the old Central States Section, later serving as A. W. W. A. director from that Section, was drafted for the post. And, Lloyd Nelson is to carry on where Carl Hechmer leaves off, to take on the less exacting office of vice-Chairman.

The following is the 1940-41 slate presented by the Nominating Committee, and unanimously approved.

Chairman
Edw. S. Hopkins, Filter Engr., Baltimore, Md.

Vice-Chairman
Carl A. Hechmer, Dept. Eng., Washington Suburban San. Dist., Hyattsville, Md.

Secretary and Treasurer
Lloyd Nelson, Eastern Sales Mgr., U. S. Pipe & Foundry Co., Philadelphia.

Trustees
J. C. Patrick, Chemist, Luke, Md.
T. V. Wood, Sales Engr., Philadelphia.
I. M. Glace, Cons. Engr., Harrisburg, Pa.
*Wm. R. Schnabel, Supt., Allentown, Pa.
*Fred E. Muser, Mgr., Chester, Pa. (*Elected this year.)

Carl J. Lauter, Chemical Engineer, Dalecarlin Filters, Washington, D. C. (Filter Wash Symposium Leader.)
Norman J. Howard, Director of Purification, Water Division, Toronto, Ont. (The President of A.W.W.A.)
Harry Krum, Supt. of Filtration, Allentown, Pa. (Vice-President Penna. Water Operators Assn.)

(A. W. W. A. Director from the Section is Dr. Abel Wolman, Johns Hopkins University, who the Section voted by resolution to back as its candidate for the office of Vice-President of A. W. W. A.)

Technical Sessions

(Chairman Glace Presiding)

In a brief welcoming speech, A. W. James, President of the Wilmington Council, praised the service of the Water Department and the work of W. C. Wills, its Manager and Chief Engineer, and the services rendered municipalities by the A. W. W. A.

"Flood Forecasting Service in Pennsylvania" by John W. Mangan, District Engr., U. S. Geol. Survey, Harrisburg, Pa.

Mr. Mangan reported on progress made since 1937 in improving flood forecasting and the communication of warnings in Pennsylvania. This involved the establishment of 100 new precipitation and 168 stream gaging stations, sufficient to give data making possible forecasts from headwaters to outlet of the more important streams. The Sherman-Bernard unit-hydrograph method of forecasting has been adopted. The Pennsylvania Department of Forests and Waters, as a part of the Federal-State Flood Forecasting Service being introduced in several states, is the first to install its own high-frequency radio communication system for one entire river basin, with a sending instrument at each important gaging station. With Federal aid the program is being extended into other flood suffering states.

"Factors in the Control of Reservoir Silting" by Carl B. Brown, Head, Reservoir Section, Soil Conservation Service, Washington, D. C.

Mr. Brown's paper proved to be one of those "A. A. A." rating documents, no less well presented than written and deserving of the high compliments it received. Since Mr. Brown's topic is of truly national breadth, interest and application of methods and predictions evolved, it is to be revamped to include territory beyond the East and presented before the A. W. W. A. at the Toronto Convention in April. We will, therefore, attempt here to touch only the high spots of Mr. Brown's splendid treatise on reservoir silting studies, the prediction of useful reservoir life and some corrective methods advocated.

Mr. Brown first described the silt depth measuring "spud," its use and methods pursued in making reservoir

bottom surveys. With this and other instruments, 96 reservoirs in the U. S. have been completely surveyed and mapped to reveal silt contours. In all, 421 lakes in 34 states have been surveyed, 151 of which are primarily water supply sources.

In determining the probable useful life of a reservoir, a loss of 20 per cent of gross capacity is the lifeline, so to speak. Some silting rates in Eastern reservoirs revealed the following per year:

	Per cent
Burnt Mills, Md.	6.0
York, Pa.	2.5
Alexandria, Va.	0.2
Frederick, Md.	0.03

The average silting rates for all eastern reservoirs studied are:

Reservoir Size	*Avg. Loss/Year, Per cent*
1 to 25 acre-ft.	2.77
200 acre-ft. and larger	0.28

The relationship of reservoir size to drainage area, and a study of silting rates observed, justified the recommendation that the size should be not less than 75 acre-ft. per 100 sq. miles of watershed area involved if a 100 year life expectancy for the reservoir is to be realized. Thus, emphasized Mr. Brown, the smallest permissible shed area should be chosen in planning and locating reservoirs which are to receive turbid waters.

Concerning reservoir desilting, Mr. Brown said that draw down by full opening of bottom gates was next to useless, only about 2 per cent of the silt (that immediately ahead of the gates, plus a stream channel) being all that is removed by such flushing procedures. Desilting with dredge or scoops is rarely justified, experience indicating the cost to be 5 to 50 times that of providing a new reservoir. In this regard, he cited experiences and costs for the White Rock Reservoir at Dallas, Texas, which lasted 18 years.

In the way of preventive and corrective measures the following were suggested:

(1) A predetermination of most probable silting rates before locating reservoirs, taking into account the ratio of water shed area to reservoir capacity.

Hosts
(Wilmington Water Department)
A. J. Feeney, Superintendent
J. R. Steel, Asst. Supt.
W. C. Wills, Chief Engr. and Gen'l Mgr.

(2) Operating bottom gates to their capacity to pass all flood-waters, it having been observed that silt laden water dives and travels along the bottom from reservoir head to dam, in front of which the maximum deposition is usually observed. This scheme has been proving very effective in the Southeast and the West.

(3) A program of soil erosion control and reforestation. In this regard the states of Pennsylvania and Maryland now have in force enabling acts which make possible the setting up and financing of Soil Conservation Districts, there being 3 million acres covered by such districts already in these states. In this scheme land owners (conservers) and municipalities may cooperate to save soil, correct silting and materially reduce the cost of coagulating and clarifying the raw water supply. The latter had been clearly revealed in 12 representative filter plants in North Carolina, studies revealing a potential saving of $1,890,000 annually ($1.50 per m.g.) by reducing silt and turbidity by 30 per cent only.

Harry R. Hall, Chief Engr., Washington Suburban Sanitary District, Hyattsville, Md., paid high compliment to the reservoir silting studies and Mr. Brown's work, as a very definite contribution of reservoir designers. The Burnt Mills Reservoir (the guinea-pig in the early approach to the problem and in planning these studies), Mr. Hall pointed out as one of the best Eastern examples of the faulty relationship between capacity and shed area. Fact is, the ratio is only 6 acre/ft. per 100 sq. mi.—far short of the 75 acre/ft. which Mr. Brown's data shows desirable for long service life. Some idea of the high cost of desilting had been gained in estimates made in selecting the location of a future reservoir for the district on the Patuxent River. Each desilting at cost of $160,000 gave an annual cost of $17,000 per year. This clearly indicated the amount of extra money that can be spent to avoid silting and desilting.

N. B. Lyle, Vice-Pres. and Gen. Mgr., Scranton-Springbrook Water Co., Scranton, Pa., said that Mr. Brown's work had interested him greatly because his company with more than 100 reservoirs valued at $57,000,000 had recently gone through a desilting operation at a cost of $170,000 for the main reservoir of the Scranton system. They owned many miles of watershed and had spent considerable in reforestation involving 6,000,000 plantings. His company paying 24 per cent of its income as Federal tax annually, would welcome some of the same assistance being given in municipal operations, and a study of Scranton reservoirs such as Mr. Brown had so ably reported upon.

(Note: This man Brown is a good fellow for water works managers as well as designing engineers to know if you are having or expecting to have reservoir silting troubles or anxious to avoid them. To hear his discussion and put in questions to him will be alone worth the price of a ticket to the Toronto Convention of A. W. W. A. and back.—Ed.)

Other complimenters and discussors included L. H. Enslow, who had some experience with reservoir silting at Spartanburg, S. C., short circuiting underflow of turbid freshet water, high cost coagulation and higher cost removal of silt-built islands which grew from the bottom up no further away from a religiously operated blow-off line than a cat could jump. Experiences in Panama confirmed the great effect of a temperature difference of only 1 degree F. in causing influent water to dive to the bottom of small reservoirs and clarifying basins and rise at the far end too soon thereafter for the comfort of any operator.

(1) R. C. Beckett, State San. Engr., Dover, Del., and W. D. Collins, Chief of Water Div., U. S. Geol. Survey; (2) "Al." Brumley, Activated Alum Corp., Baltimore, and "Ross" Scott, Engr., Dresser Mfg. Co., Bradford, Pa.; (3) Harry R. Hall, Chief, Washington Sub. Sanitary Distr., and "Ed." Canton, Badger Meter Co., Baltimore, Md.; (4) "Bob" Hayworth, Ind. Chem. Sales Co., Gastonia, N. C., and Remie I. Dodd, Supt. Filtration, Chester, Pa.; (5) L. L. ("Hedge") Hedgepeth, Mgr. Technical Service, and "Ted" Wilson, Sales Division, Pennsylvania Salt Mfg. Co., Philadelphia.

Mr. Brown, then, to illustrate the decided effects of turbidity and silt in creating bottom under flow as contrasted with temperature differentials, cited the case of Elephant Butte Reservoir, wherein the diving incoming water had a temperature actually 6 degrees higher than the reservoir water above it. With temperature only slightly lowered it reached the dam, still at the bottom. Upon analysis this so-called "water" was found to be carrying 5 per cent mud, which more than offset the gravity lowering 6 degrees of higher temperature. Strange to conceive the water proper had so little tendency to part company from its silt and mud cargo and rise to overturn the cooler water above.

E. A. Smith, U. S. Engineer's Office, Washington, commented that Mr. Brown's paper seemed to be exceptionally satisfactory, and impressive was the matter of potential chemical savings through effective control of erosion, or preliminary silt separation as second choice to the first. He then asked if municipalities could advance funds to upstream owners for use in erosion abatement.

In reply, Mr. Brown suggested that even if cities could not directly finance such out-of-city undertakings, they could do a great deal in the direction of getting projects organized and under way.

Symposium on Filter Washing

Under leadership of Carl J. Lauter, Chemical Engr., Dalecarlia Filters, Washington, D. C., two hours of one session was devoted to a symposium on "Filter Washing" consisting of 8 short papers and a general discussion open to all. The only shortcoming was that too little time was allotted to the topic. To leave on the scheduled inspection trip, the general discussion and questions directed to speakers had to be cut short.

Mr. Lauter, in opening the symposium with a comprehensive general statement, defined what may be termed "a properly washing filter," in which he discussed the basic principles of filter bottom design, washing practice, and make-up of the filter bed. In analyzing the effectiveness of high and low-rate filter wash, the varying summer and winter water requirements to properly expand the bed, types and sizes of filter media, and other basic considerations, Mr. Lauter ended with the conclusion that surface wash or some other method of augmenting upflow wash to effectively scour the grains seemed to be

(1) *"Hal." Hutton, Sales Mgr., Wallace & Tiernan Co., and "Joe" Hayes, Neptune Meter Co., Pittsburgh;* (2) *Prof. Homer Turner, State College, Pa., and Homer Beckwith, Distr. Engr., The Pitometer Co., Pittsburgh, Pa. (At State College one was "Homer, the Prof."; the other "Homer, the Humble.")*

an essential to successful cleansing and, therefore, *proper* filter washing.

"Why Sand Expansion Is the Proper Indicator of Effective Filter Wash" by Roberts Hulbert, Asst. Supt. of Filtration, Detroit, Mich.

To argue for high-rate wash and proper sand bed expansion as the correct index of effective filter washing—the method developed at Detroit by Messrs. Herring and the speaker—Mr. Hulbert was invited to come on and take part in the symposium.

In considering the efficacy of high-rate washing, Mr. Hulbert said that all hinged on three main factors. The first was the requirement of not less than a 50 per cent expansion of the bed; and the second was the wash (volume) requirement to scour the bed. The latter hinged on water temperatures, since the gravity of water at 70° F. is just one half that of winter water at 32° F. In practice a 16 in. vertical rise of 32° water will do the work of the 30 in. rise required at water temperature of 64° F., and still more at temperatures higher.

The third and highly important factor is the size and shape of sand grains, or other material employed. Since water velocity between the suspended grains is the important consideration, it was interesting to learn that a difference in grain sizes of 0.45 and 0.55 m.m. gave a 41 per cent difference in intra-grain velocities, the greater the grain size at a given expansion the higher the cleansing velocity. Likewise less total surface to cleanse existed on larger grains and the greater is the effective rubbing together of the larger grains. Further, the more angular the grains, and the lower the density or gravity of the media, the greater the expansion at given wash rates—summer or winter. From all of this it was apparent (in fact axiomatic) that the coarsest filter media permissible should be used to secure the best results with high velocity wash, the least tendency to mud ball formation, and the cleanest beds top to bottom.

Mr. Hulbert exhibited the finer top sand of 1928 and the coarser sand of recent years in the Water Works Park Plant to prove his contentions. The high velocity wash had automatically flushed out the fines since 1928. At the Springwell's Plant of Detroit the finer sand was producing small mud balls with high-rate wash. On the other hand the "Anthrafilt" units alongside, with lower gravity and coarser grained media, had been kept exceptionally clean at 50 per cent expansion, involving less wash water because of the low gravity of the material.

"Measurement of Washing Rates and Indication of Bed Expansion," by Harry J. Krum, Sup't. of Filtration, Allentown, Pa.

Mr. Krum told of the commonplace difficulty of getting filters washed uniformly by shift operators who attempt judging the wash by eye, or even with a wash meter reading and a watch. It being apparent that something more definite was needed to secure an adequate washing, and some uniformity on every shift, he had set about developing an indicator for degree of bed expansion as the basic rquirement of up-flow wash when taken alone. After considerable experimentation and construction of a model filter, a sand float of conical shape (top and bottom) proved the most satisfactory and dependable shape. The "Bed Expansion Indicators" subsequently have been constructed of sheet copper and properly weighted, all Allentown beds being so equipped. With the cooperation and assistance of The Simplex Valve and Meter Co. further refinements had been made and rights to manufacture and sell the units had been assigned this company. A chord from the float to an indicating dial reveals the degree of bed-expansion and proper stopping point in wash valve opening. No longer does attention have to be paid to water temperature changes, the grain size or the gravity of the media as formerly. Through this device uniform and dependable filter washing had been attained. (The "Sand Bed Expansion Indicator" developed by Mr. Krum, is described in an article by the inventor and E. M. Jones in WATER WORKS AND SEWERAGE for October 1937. To those who have not this issue reprints are available.—Ed.)

Although the indicators played an important part in securing the best wash obtainable at 50 per cent bed expansion and vertical wash rise averaging 30 in./min., the sand seemed to need more effective scrub-

bing. In consequence, one of Palmer's (Erie, Pa.) "Filter Sweeps" had been given a trial. The results were somewhat eye-opening. In conjunction with the "Bed Expansion Indicator" it had become apparent that a 20 per cent expansion of the bed when operating the revolving Palmer Bed Agitator was more than adequate. In fact a 15 per cent expansion, sufficient to make the bed fluid, was to be employed in the future with the scrubbing jet agitator doing the real work.

It was particularly impressive said Mr. Krum after washing a filter clean (?) with high velocity wash of 50 per cent expansion to see what later happened to the wash water when dropping the up-flow to 15 per cent expansion rate and turning on the Palmer "Filter Sweep."

Mr. Krum earlier explained that there was nothing that could be blamed on filter design and washing facilities at Allentown. The filters are equipped with false bottoms of the Leopold design which produces adequate uniformity in distribution.

"Filter Bottoms—Design Features of Importance," by H. B. Crane, Ass't. Chief Engr., International Filter Co., Chicago.

Mr. Crane presented a quick and inclusive illustrated description and evaluation of the features of four designs of modern filter bottoms of the false bottom type as follows:

(1) *The Porous Plate Bottom*—Its advantages being economy producing conservation of head and reduced flow line through the plant; elimination of troublesome gravel layers; ability to employ air and water wash through the same plates forming the false bottom. The possible disadvantage is the liability to clogging of the pores in the 1-inch thick plates, however their cleansing with alkali or acid was not any considerable problem. Getting at the plates was no problem because there was no sand and gravel mixing to consider in this operation.

(2) *The Wheeler Ball Type*—This false bottom, involving the use of clay balls in inverted pyramidal pockets and a small layer of fine gravel only, had the advantage of low head loss, good distribution and freedom from corrosion of cloggage problems. No disadvantages were named.

(3) *The Leopold Duplex False Bottom*—Consist of concrete laterals with porcelain nozzles beneath finely perforated hollow concrete blocks inverted over the nozzles. These bottoms are corrosion proof, low in head requirements, require fine gravel only.

Wm. R. Schnabel, Supt. of Water, Allentown, Pa. (New Trustee.)

Geo. L. Hall, Chief, Engineering Div., Md. Dept. of Health, Baltimore.

(4) *The Wagner Bottom*—Is extremely simple and inexpensive in design, having laterals of perforated "Transite" pipes covered by inverted hollow blocks of concrete, with slitted bottoms, supporting the gravel layers. The advantages are freedom from corrosion, low head losses, good distribution, freedom from clogging, low first and maintenance costs.

"Anthrafilt and Sand-Anthrafilt Combination Filter Bed Washing," by Homer G. Turner, Research Engineer, The Anthracite Equipment Corp., State College, Pa.

"Prof." Turner in characteristic style drew a word picture of filter washing "to illustrate what it takes" to cleanse the grains. He couldn't picture an effective automobile wash by high velocity hose stream alone. When through the mud film was still there, even after an hour of such "high velocity" wash. On the contrary, take a rag or sponge for rubbing and only a trickling hose stream for a rinse and you've done something. In this manner "Prof." Turner set the stage for the low up-flow velocity and scrubbing type jet-agitator as the only truly effective filter wash in his opinion. Once having loosened the films on the grains the purging wash from beneath would complete the job and effectively grade the bed. He said that basically there was no difference in washing "Anthrafilt" or sand-Anthrafilt beds than all-sand beds. The "Anthrafilt" was smoother, however, and more easily cleansed.

"Surface Wash Types—Their Relative Efficiency," by Philip O. Macqueen, Engr., U. S. Army Engr., Washington, D. C.

Mr. Macqueen, who occupies the position of Filtration Engineer in Washington, took a look back at filter design history when he said that the "Era of Mud Balls" started about 40 years ago when the rectangular concrete filter came into style. With present developments it appears that the historic round tub filters, with their mechanical bed stirring rakes and chains, "really had something" after all. Then when concrete filters exhibited washing deficiencies the airwash came into vogue for a short life of favor, due mainly to air pipe cloggage troubles and bed inversion. Then the high-velocity wash was introduced as the real solution, only to prove a disappointment in many instances. In recent years Baylis came forward with a scheme that really seems the answer. He called it the jet surface wash but it really goes beyond the surface where, however, most of the dirt first accumulates. Still more recently has appeared the Palmer revolving type of jetting bed agitator developed at Erie, Pa., and every new plant of consequence is incorporating one or the other means of providing surface wash—or, more properly, sand scour.

In the Washington experiences in trying a surface wash installation on one filter, Mr. Macqueen said that it was impressive and one or the other system was to be employed—both seemingly excellent. In considering the high velocity wash system at Washington, some time ago, it proved prohibitively expensive to redesign for it, whereas equipping with the surface wash scheme involves no serious problems for existing plants.

"The Two Stage Filter Wash," by Edward S. Hopkins, Filtration Engineer, Baltimore, Md.

Mr. Hopkins, the section's new chairman, described washing methods developed at Baltimore. A practice, long discontinued as a worthless "gesture," was that of filtering to waste, known as the "rewash" before returning a washed filter to service. The next development was to determine how long a filter should be washed, upflow-water wash only being the method. By control tests and observation it was determined that beyond a residual turbidity in the waste water of 75 p.p.m. further washing proved a waste of water and effort. Washing longer to lower turbidities of waste produced no better effluent, no longer filter runs, no less bed troubles. Toward the end of the wash operators catch trough samples at 90 second intervals and close down when the 75 p.p.m. turbidity is reached—much wash water being saved in consequence.

The more recent innovation has been the "two-stage wash" which had resulted in less mud ball formations, decidedly, and longer filter runs probably. The scheme involves: (1) A primary wash for 90 seconds at roughly 10 gals./sq. ft./min. rate, which is usually sufficient to reach the 75 p.p.m. turbidity point in the

waste; (2) The completing wash (without closing the wash valve) involves a boosted wash-rate sufficient to insure a 50 per cent bed expansion (if possible to get, injected Mr. Hopkins), and this increased rate is continued until the testing shows that the increased waste turbidity, resulting from the higher rate, has again receded to the 75 p.p.m. standard practice figure. Mr. Hopkins said that the general average of overall time from starting a wash to completion is about three minutes of first stage and two minutes of second stage wash. As we understood it, correct wash periods are determined by the laboratory force every Monday and these periods are adhered to by the filter attendants during the week. (Although the surface wash scheme was conceived by Baylis while at the Baltimore plant, and there first demonstrated, it seems strange that Baltimore has never gone further in adopting the system. —Ed.)

Chas. Trowbridge, Chief Sanitary Engr., American Water Works and Electric Co., a scheduled participant but unable to attend, sent in his written discussion. In it he called attention to the limitations of high velocity up-flow wash, and the fact that an over-expanded bed is not effectively washed and is a waste of water and effort, because of less contact and reduced rubbing of grains against grains when too widely separated.

In the too short general discussion, Mr. Hulbert was asked what was the largest size of sand he would consider satisfactory for filtering. He replied that the sand of 0.75 to 0.8 mm. effective size now in use at Detroit Water Works Park Plant has certainly been satisfactory providing there was no breakdown in coagulation efficiency.

Linn H. Enslow, Editor, "WATER WORKS AND SEWERAGE," said that this matter of quality and size of filter media struck a responsive chord, because of his own operating experiences and observation. He had experience with a sand of 0.72 mm. size and another sand of 0.35 mm. size filtering the same water back in 1920. Incidentally these filters were of the tub type. One set contained sand meeting the State Sanitary Engineering Division requirements as to size, but these filters were always in bad shape even though the bed stirring rake mechanism was operated. The filters with the 0.72 mm. sand had no rakes and no rate controllers and were generally condemned by the code of good filter practice at the time, and the

N. B. Lyle, V. P. and Gen'l Mgr., Spring Brook Water Co., Scranton, Pa.

Chas. J. Bruce, Superintendent, Evitt's Creek Water Co., Cumberland, Md.

A. G. Fiedler, Div. Ground Waters, U. S. Geological Survey, Washington,

State Sanitary Engineer. But, the impressive part was the consistent cleanliness of the coarse grained beds, which never had a mud ball, in comparison with the very unsatisfactory condition of the fine grained filters. The coarse filters could not be operated on loss of head, however, for obvious reasons. They were washed whenever the effluent showed the first signs of turbidity coming through. This experience has long been remembered, and although there was no high-velocity wash in those days these units produced very acceptable results and were trouble free at least, unless as Mr. Hulbert pointed out. the coagulation was not in good shape. At such times the fine grained filters turned out a superior water—so there are two sides to the question of where, when and how far to depart from sand of medium size—more particularly in the less well manned plants of the smaller sizes.

Mr. Enslow said that it was a pity that air-wash had not been perfected to a more practical degree. This statement was prompted because of his experience with, and high regard for, properly functioning air wash. It was certainly in the right direction as now is proven by the effectiveness of bed jetting. A highly interesting filter development in England and South Africa was then sketched and described. The washing system consisted of a preliminary air scrubbing wash (no water) followed by what is termed "bed tipping." In the latter operation (air off) the dirt now at the surface, due to the air-wash, is swept into a very low freeboard side gullet by a low velocity water wash and cross current. The gullets are then closed by air-lock and the regular wash troughs come into play to complete the wash at short economical moderate velocity rate. The basic principles of cleaning a filter bed were all there. Such a design, if leaving out the gravel and substituting porous plate false bottoms, suggested very interesting possibilities in the direction of economical design and maintenance, as well as efficient and trouble-free operation.

It was no longer a doubt that the surface wash, first advocated by Baylis and now with Palmer's units, was about the most effective means of filter washing yet experienced in this country. The distinctive advantage was that the scheme could with ease and justified expense be fitted into existing as well as new plants.

I. M. Glace, Cons. Engr., Harrisburg, Pa., said that his observations at Krum's well operated Allentown plant was more convincing regarding the merits of surface wash than anything that had come to his attention.

Here the meeting was adjourned for the purpose of making the tour of inspection of the Wilmington Filter Plants.

THE GROUND WATERS OF DELAWARE

The Friday morning session was opened with a paper by R. C. Beckett, State Sanitary Engineer of Delaware, revealing the characteristics and quality of municipal ground water supplies in Delaware, which comprise 28 of the 31 public supplies (5 company owned) in the State.

The well supplies of Delaware may be divided into two groups—(1) those from wells 20′ to 100′ in depth; (2) those from 100′ to 496′ in depth. Waters from the first group are characterized by an average total hardness of 54 p.p.m., a pronounced CO_2 content of 36 p.p.m., and pH of 6.5. The wells of more than 100-foot depth yield waters averaging 111 p.p.m. hardness; 9 p.p.m. CO_2 and pH of 7.4. In addition to their aggressiveness (high CO_2 content) the iron content is objectionably high (1.4 to 7.4) in the majority of cases (the shallow supplies in particular) and several aeration and iron removal pressure filter plants have been installed. Red water troubles are prevalent. For correcting this objection "Calgon" has been effectively employed in one company owned supply having a hardness of 20 to 30 p.p.m.; CO_2 content of 13.5 parts and an initial iron content entering the mains of only 0.5 p.p.m. The shallowest supply, to the largest population served well water, runs 55 to 66 parts of CO_2 before aeration, and the iron content 4.4 to 7.4 p.p.m.

Mr. Beckett pointed out that the sanitary quality of these ground supplies is universally satisfactory but more effective and prevalent treatment for CO_2 and iron removal is needed to render them satisfactory in general. The average iron content of 3.4 p.p.m. for all ground supplies,

(1) *H. B. Crane, Ass't Chief Engr., International Filter Co.;* (2) *R. I. Dodd, Sup't Filtration, Chester, Pa.;* (3) *"Bill" Eastburn, Mathieson Alkali Wks., New York City;* (4) *Leon S. Duckworth, Sup't Filtration and Pumping, Lancaster, Pa.;* (5) *"Bill" Cambridge, Hersey Meter Co., New York;* (6) *Chas. P. Abraham, Sup't of Water, Lancaster, Pa.;* (7) *Nobel L. Owings, Ass't Engr., Washington Suburban San. Distr.;* (8) *Philip Macqueen, Filtration Engr. (U. S. Engrs.), Washington, D. C.;* (9) *"Art" Welch, Ind. Chem., Sales Co., Philadelphia.*

and maximum of 7.4 p.p.m., tells the iron story of Delaware waters. Almost invariably the deeper waters are the more satisfactory supplies chemically and amenable to economical treatment. The 230 ft. wells of Dover yield a great abundance of non-aggressive water of 110 p.p.m. hardness, no iron, and a CO_2 content of but 1 p.p.m.—an ideal water for partial softening by the Zeolite process if and when the taxpayers demand a softer water.

(It was noted from Mr. Beckett's paper that industrial supplies for "Rayon" and "Nylon" production were taken from the deep source and readily treated to produce water of the very high quality demanded in manufacture of these products.)

W. D. Collins, Chief of Water Quality Div., U. S. Geol. Survey, Washington, in discussing Mr. Beckett's paper, contributed a tabulation of analyses of Delaware's public water supplies. Except for aggressivity and high iron content the wells of Delaware yield high quality waters easily treated for both objectionable qualities, said Mr. Collins.

"Insurance Requirements for Water Works Properties," by R. F. Goodhue, Fire Protection Engr., Middle Dept. Rating Ass'n., Philadelphia.

Mr. Goodhue, stressing the value of decentralization of important water supply equipment, cited the Buffalo case wherein all motors and pumps in the main station were at one stroke put out of commission when the single pump pit was flooded —a serious situation for the City. He also advocated filter plant design permitting of operation of one half of the plant with the other out of service in any emergency. The value of elevated storage needed little retelling. The requirement of oversize pipes in distribution systems and for private fire lines was a sore spot but as long as pipes tuberculate and lose capacity with age the only safe procedure is the seemingly wasteful one of anticipating a delivery depreciation of 66 per cent, in time. Mr. Goodhue said that the insurance fraternity deplored the flat rate hydrant rental scheme because the return did not stimulate an improved system of more adequate mains such as the inch-foot basis of charging for hydrant and main facilities effectively did, the latter being the only sound method of charging for fire protection provided.

Chas. Haydock, Consulting Engr., Philadelphia, presenting an interesting discussion, said that the earliest recorded fire service dated back to 22 years before the Christ, when a company of 600 slaves was organized for public fire fighting. The high cost to the small community or company in providing facilities for fire protection, over and above domestic use requirements, was evident when realizing that the small system for fire service cost 200 per cent additional as compared to 8 per cent additional investment in the larger cities.

Until the present war, fire fighting facilities had not constituted a major protective measure. However, now with planes able to drop 2,000 incendiary bombs per hour, containing the extreme heat evolving thermit mixture, it was evident that hundreds of fires starting simultaneously in widely separated sections of cities was no problem of small proportions and something bringing fire fighting facilities into the front ranks of defense measures.

DISTRIBUTION MAINTENANCE

"Practices in Distribution System Maintenance," by Fred E. Muser, Exec. Manager, Chester Municipal Authority, Chester, Pa.

Mr. Muser, until a short time ago manager of the company-owned water system of Chester, Pa., and now municipally operated, had a splendid paper which was read in his absence by Mr. Haydock.

The opening paragraph stated that nowhere better than in distribution system maintenance was the saying that "The road to hell is paved with good intentions" a more meaningful statement. (Now facing the expenditure of $1,000,000 to correct defects, Philadelphia was a splendid example, this sum being referred to as a "deferred maintenance" item—said Mr. Haydock.)

Mr. Muser commented on the internal depreciation of mains and the effects on water quality. In this regard systematic flushing programs had been found of more value than ordinarily realized—such a program not only improving water quality but also revealing system deficiencies, the condition of important line control valves and whether open or closed. Concerning reserve stocks of materials, unless the adage "A place for everything and everything in its place" was made to apply reserve supplies and equipment might show on paper —but, where else? In other words "good-housekeeping" seemed of prime importance in maintaining cleaner mains and better quality water as was true in store room and stock yard management.

Carl A. Hechmer, in reporting on Washington Suburban Sanitary District practices said that all valves and hydrants are inspected not once yearly but twice, and all important hydrants more frequently than twice. In the matter of hydrant maintenance and repairs, a close contact is maintained with the Fire Department which notifies the Water Department of every hydrant used and conditions in which found.

Homer Beckwith, Distr. Manager, The Pitometer Company, Pittsburgh, said that lots of things happen to neglected mains and valves, and unless at least one test of valves is made annually the packing will be dried out. Mr. Beckwith also commented on the question of abandoned and often forgotten services, and cited a water loss of 300,000 g.p.d found by a Pitometer survey in a single city block where there were five such abandoned services leaking and entering the sewer. He advocated plugging the main when abandoning a service line.

N. B. Lyle, Gen'l. Mgr., Scranton Spring-Brook Water Co., Scranton, Pa., pointed out the necessity of knowing the location and condition of valves in order to establish the worth of a water distribution system, therefore the value of keeping records. Scranton has probably one of the

highest maintenance costs of any system, due to the mined out areas under the city and continuous ground shifting, resulting in an average of 1,800 leaks annually. The system is thoroughly mapped and an emergency crew is maintained for service at all hours.

JORDAN ON CONFLICT AND COMPROMISE

The meeting was closed with one of "H. E. J.'s" heart-to-heart talks on what's in his mind at the moment. They generally make good listening and this one was no exception. He titled his impromptu remarks "A Page From the Education of Harry Jordan." In this he had learned of the frequent necessity for adjustment

Reeves Newsom, Cons. Engr., New York, N. Y. (Past-President of A.W.W.A.)

George Wirtz, Pres., Atlas Mineral Products Co. (Committee on Local Arrangements.)

Charles Haydock, Cons. Engr. of Philadelphia

of conflict and compromise in water works operation. For instance, water plants never collect a fair income commensurate with costs of supplying fire protection. The question of how to arrive at a proper balance is no better answered today than it was "yesterday." Then there is the question of electrical grounding to water pipes. Should, or must, water systems continue to be used as a "sewer" for electricity. Here is a conflict needful of adjustment and compromise.

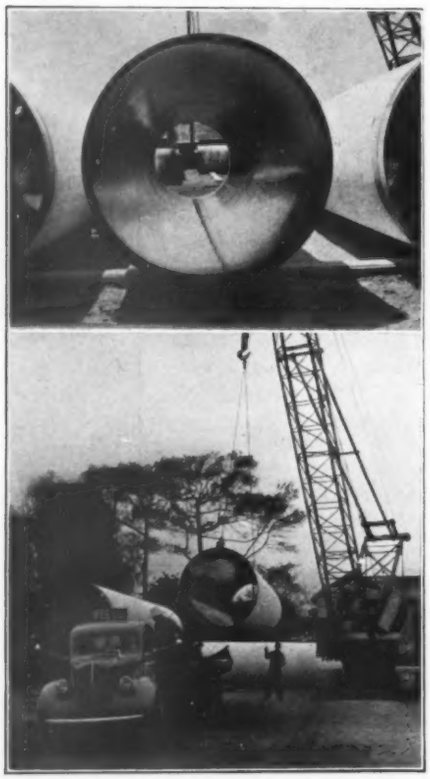
The "H. E." cited the need for a larger "voice of the management" in matters pertaining to distribution in A. W. W. A. meetings and affairs, such as has been so effectively done in A. W. W. A. by the purification men.

(*Adjournment*)

(The 1941 Meeting of the Section is to be held in Baltimore.)

LOS ANGELES THOUGHT TO HOLD RECORD IN PIPE LINING OPERATIONS

For sometime now the Bureau of Water Works and Supply of Los Angeles has operated its own pipe lining and coating plant. In the history of this activity the Bureau has done much in the way of studying bituminous enamels and cooperating with manufacturers of these protective materials. The result has been a material improvement in such enamels for water works and sewerage service.



Sections of Finished Pipe.
(*30 ft. Long, 5 ft. Diam.*)

The accompanying pictures show some of the work of the Los Angeles plant, which has turned out as much as 1200 linear feet of 60" steel pipe enameled and coated in 8 working hours. This day's operation required the processing and application of 12 tons of enamel to 140 tons of pipe, believed by W. W. Hurlbut, Ass't. Chief Engr. of the Bureau to be a record not met by any similar plant.

Mr. Hurlbut also writes that with the completion of the current project, the bureau will have installed approximately 60 miles of enameled pipe 30" in diameter and larger.

A CROSS-CONNECTION BECOMES ACTIVE IN ROCHESTER

Responsible for Waterborne Outbreak and Costs a Superintendent His Job

At this writing the details concerning the gross contamination of Rochester, N. Y., water mains, through a cross connection between Rochester's high-pressure fire mains, carrying polluted river water, and the potable water supply mains are not available.

As we go to press only the accounts appearing in the press of December 14th, and fragmentary additional reports are available. From such what appears to have happened is the following:

Assumedly, for some time all cross connecting lines between the high pressure fire service mains, carrying polluted river water, and the pure water supply mains, had been eliminated by the water department. However, it turns out that there was at least one physical connection with but a single valve separating these systems. In a routine valve testing and repacking program this valve, of which there was either no record or through a mistake by the maintenance foreman or crew, this valve was repacked, operated and left in open position according to usual valve testing practice.

After pollution was detected in city tap samples, and an investigation started, it was learned that this valve had been wide open for about 18 hours. Immediately upon discovery of the mistake heavy emergency chlorination was resorted to and water boiling notices were flashed over the city by all available means. However, we understand that a number of dysentery cases have already shown up and worse is apt to follow.

We also understand that following the investigation the superintendent of the Water Department was dismissed. On what grounds we have no information and it may well be that it is a case of someone having to be the well-known goat in cases of this nature. If he knew that this cross connection (with but a single valve) existed, he should be indicted —not fired—but we can't believe that this is a case of criminal negligence. On the other hand, it probably reflects the poor records of physical equipment in the Rochester system of an earlier day and the consequences of a non-recorded interconnection between the dangerous and the safe supplies of the city. In any event it constitutes another lesson learned.

INTERESTING!

We learn from the "Ohio Section News" (A.W.W.A.) that the Zone Soap Co. of Fort Wayne, Ind., will supply soap compounded for various types of water. That is, formulas are changed to meet various hardness requirements.

PROBLEMS IN THE MANAGEMENT OF MUNICIPAL WATERWORKS

By L. R. HOWSON*
Alvord, Burdick and Howson, Engrs.,
CHICAGO, ILLINOIS

THE term "management" as used in this discussion is much broader than the usual understanding of the process of operating a water works system. As here used, "management" includes a well formulated construction program, a sound financial policy, economical administration of operations, and the equitable allocation of revenues through the medium of fair rates, all coordinated into a unified interrelated whole.

The normal American water works is a growing institution. In predepression times, the average American city added about 3 per cent to its population each year. Inasmuch as the expansion of water facilities in general parallels the growth in population the expenditures for new construction to care for this expansion have averaged about $1.50 per capita per year. It is apparent, therefore, that a substantial part of the total water works revenues have been required for financing new construction either directly from earnings or indirectly through fixed charges on construction cost. This proportion of revenues has varied from 10 per cent to 25 per cent of the total. In recent years the rate of population growth has been relatively slow in most cities, but due to the ever rising standards of water service the investment has continued its growth.

In cities which exceed the general average rate of growth (approximately 35 per cent per decade), the requirements for capital expenditures will necessarily be larger and methods of financing, other than outlined herein, may be necessary. This discussion relates primarily to the average American city.

Every municipal water works should be self-supporting and self-perpetuating. The revenues and the rates on which they are based must be adequate to support the present service and to provide orderly expansion to care for the growth in water requirements. Adequate water rates and sound construction and financial policies go hand in hand.

This paper, presented before the 1940 Annual Convention of the New England Water Works Association, is printed by permission of the author and authorization of the Association.

L. R. Howson
Vice-President of the American Water Works Association

Financial Policy

It is believed that municipal water plants should develop a sound financial policy which, through rates, will provide sufficient revenue to pay operating expenses, interest and amortization on outstanding debt, if any, an amount sufficient to cover ordinary additions to the water works such as distribution system extensions, meters, etc., and in addition an amount to cover the average annual requirement for major additions.

The obvious result of such a financial policy is to gradually retire all outstanding indebtedness and to build a well distributed construction program from revenues.

It will be noted in the above itemization of funds to be secured from revenues, nothing is said about depreciation. It is the writer's belief that if the present generation of consumers pays interest on the outstanding debt (if any) and provides for its amortization requirements, and in addition pays for new construction out of earnings, it is certainly the responsibility of succeeding generations of consumers to provide for replacements of property from their current revenues. To charge present consumers for both amortization of debt and depreciation reserve, for replacement of previously amortized property, is an unwarranted duplication of charges.

Considered over a long term, the cost of financing from current revenues is only about 60 per cent as costly to the consumer as financing by bond issues. Costs are amortized as incurred without interest charges.

Financing from current revenues has several other very definite advantages, including the following:

1. Through being able to provide new construction when needed without resort to bond issues, the facilities are available when needed and a high standard of service is uniformly maintained.
2. Delays incident to the failure to vote bond issues and the political exigencies surrounding their passage are obviated.
3. When coordinated with a properly developed, comprehensive construction program, the bulges in fixed charges incident to bond issues are avoided, and most important.
4. The attention of the consumers is focused upon service rather than cost as is the case when financing is done by bond issues. By financing new construction from revenues the Water Department, rather than the politicians, has control of its ability to finance and furnish adequate service.

Construction Program

It is desirable that there be as few changes in the rate structure as practicable. If new construction is financed from current revenues, it is therefore important that construction expenditures be well distributed. The prime essential to the distribution of construction expenditures is the formulation of a carefully studied, comprehensive program covering the requirements for expansion to serve both the near and distant future. Such a program should currently be made and kept 20 to 30 years ahead of the present time. It should be reviewed at periodic intervals not exceeding 10 years.

The formulation of such a program necessarily starts with a forecast of population, industrial growth and water requirements. Each part of the present system is investigated with respect to its ability to meet these requirements, its present and probable future deficiencies and the time when it will become deficient ascertained, and the various practicable means of correcting deficiencies outlined, estimated as to cost and evaluated.

With such a well formulated construction program it will usually be possible to so forecast requirements with reasonable accuracy and to so provide construction essential to meet them, that the flow of capital

into construction can be kept at a relatively uniform rate.

Where such a construction program has been formulated and adopted, the following results have usually been accomplished:

1. Funds are provided for construction when needed and not before, thus on the one hand saving the fixed charges on expenditures which otherwise might be made before necessary, and on the other hand obviating the inadequacies in service resulting from delays in building large expansion programs.
2. It effects the most practicable uniformity of construction requirements and expenditures. Construction expenditures follow a smooth line rather than a saw tooth course. Smaller expenditures for construction are made each year which is preferable to accumulated deficiencies corrected at infrequent intervals.
3. By such a comprehensive program of development, each year's construction is designed to serve not only the immediate needs but to fit in best with the ultimate requirements, thus minimizing future obsolescence.

Economical Operations

It should, of course, be the aim of all management to operate as economically as possible consistent with furnishing excellent water service. Sometimes, but not as frequently as ordinarily thought, there is political interference in municipal plant operations which adversely affects economy. Economy in operations does not just happen; it is created. Among the factors contributing to it are:

1. Good bookkeeping and accounting practice.
2. Concise yet comprehensive daily, weekly, and monthly comparative operating reports.
3. An annual report, properly arranged for comparative use.
4. Comparison of operating statistics of the particular plant with others of its type and class.

Good bookkeeping is essential to economical administration. The introduction of standard methods of accounting for water utilities by state utility commissions has been of great advantage. Unfortunately in most states the adoption of this system is mandatory only for private utilities. It is believed that every municipal water works should adopt standard accounting practice *without being compelled to do so.* The use of standard accounting methods has been of great advantage to the private utilities; it will be of even greater advantage to municipal plants whose accounting practices are frequently more lax.

There should be a system of daily, weekly, and monthly reports from department heads to the manager. These should be informatory rather than routine, brief, yet sufficiently explicit to enable the manager to promptly detect and correct variations from normal.

Municipal water works should prepare their annual reports along standard lines. Some years ago a joint committee of the N.E.W.W. Association and the American W. W. Association prepared a form titled "Essential Statistics for Annual Reports of Water Works." Mr. Metcalf and Mr. Rogers represented this Association. If all municipal plants would use this form (see Water Works Manual of the A.W.W.A.) the comparison of the individual plant's operating with others would be much facilitated and much more accurate.

There are two primary reasons for an annual report:

1. The Beneficial Effect on the Management Itself.

Just as the author of a paper usually derives more benefit from its preparation than those who read it, so the greatest benefit from a good annual water works report falls upon the management. The preparation and anaylsis of the statistical data is essential to the best understanding of one's particular property. The preparation of the annual report should not be a routine matter consisting of tabulations by accountants compiled once a year. Its data should be constantly before the manager or superintendent, month by month, in form to disclose any variations from previous months or years.

Good management detects variations in operations when they occur, not later. A good report is a live, potent, functioning essential of management rather than a dead recital of past occurrences.

2. Its Value in Indicating Possibility of Improvement.

Sometimes we learn much by a comparison with others in the same line of endeavor. If the annual report data is in standard form, comparison is facilitated and greater accuracy assured. By comparison items are easily selected for more detailed analysis. For illustration, in a recent water rate investigation, where it was first of all necessary to determine the reasonable operating expenses of the future, it was found that the unit costs of meter reading and collection were approximately double the average in other cities of similar size. An investigation disclosed that there were currently approximately 30 per cent of the consumers delinquent and the total delinquencies amounted to one-third of one year's revenue. All current bookkeeping was done by machine but delinquencies were transcribed to the bills by hand. This handling of about 30 per cent of the accounts more than doubled the normal cost of collection and bookkeeping in that particular city. It was accordingly recommended that every effort be made to reduce the present delinquencies, that a firm shut-off policy be adopted and followed without political interference, and that in cases where it was claimed that absolute poverty prevented payment of the bill, the "trickle treatment" be administered. [This consists in placing a perforated disc in the consumer's connection with an opening so small that the flow is restricted to an amount which will furnish water for the absolute necessities of sanitation, but which requires so long to fill a bucket or tea kettle as to provide every incentive of paying the bill as soon as possible. This "treatment" has been quite successful in reducing delinquencies.]

By analysis and comparison with other cities of comparable size it was found that in a particular city, while all other departments were relatively efficient, the commercial department was inefficient throughout. The average number of meters read per employe per day was approximately 30, and the number of bills gotten out per clerk per day was less than 20. The annual commercial expense of meter reading, collecting, billing, and accounting averaged approximately $3.00 per meter as compared to a general average of $1.50 or less. The number of consumer accounts handled per employe was only approximately 600 per year, as compared to a general average of 1,200 and an outstanding performance, such as Cincinnati, or nearly 1,800.

In another city it was found that the automobile expense was excessive by comparison with 14 other cities in the same general population classification. It was found that the number of cars per 100,000 population was 22 as compared to the average of 12½ in the other cities, and the number of cars per 100 miles of mains was 10 as compared to the general average of 5.5. Investigation disclosed that these cars were individually assigned, unmarked except by a special license plate, that the average mileage per car per mile of main in the system was approximately 2½ times that of the average in other cities, that the average annual cost expressed in terms of dol-

lars per mile of main or per capita served was about three times that of the average city. By a pooling of cars and the providing of a central garage, a saving of approximately $40,000 per year was practicable.

These figures are cited simply as illustrative of the benefits that can be derived from keeping records and cost accounting in cities on a standardized basis. The management in any particular city should check his operations with those of similar cities and plants and if the figures are accounted for on the same general basis, they will furnish a helpful guide in locating weak spots in his own organization. Every large organization has some department head with bureaucratic tendencies, sometimes so gradual in their expansion as to escape detection unless checked comparatively with the experience of others. Good reports help to "know thyself" and to do as well as, or better than, others.

Factors Affecting Water Rates

It is the function of the rate schedule to equitably allocate to the various classes of consumers their proper proportions of the total revenue requirements. One of the principal factors in determining fair rates is the proportion of total pumpage which is revenue producing. Obviously the lower the percentage of revenue water the higher the average rate per 1,000 gallons must be. This percentage is affected by such policies as ownership of meters, free water, use of hydrants, etc.

Ownership of Meters

In a considerable number of municipalities the meters are owned by the consumer. Usually when repairs to the meters are made, the consumer pays the expense. A survey of over 80 completely metered water works. classified only with respect to ownership of meters, disclosed the fact that the meters were registering about 6 per cent less of the pumpage in cities where the consumers owned the meters than where they were owned by the utilities. The reason is obvious. The consumer is not interested in accurate registration. The more inaccurate, the better for him as a water meter ordinarily cannot overregister. With increased wear the underregistration increases. Meter repair is an annoyance and expense to the private owner but a means of increasing sales and revenues to the city.

A further disadvantage in consumer ownership arises from the fact that during the period while the meter is removed from his service for inspection or testing, the water is usually furnished to him unmetered through a "jumper" connection. Investigation of consumer ownership pactice has disclosed that frequently a "jumper" connection is in position for two months or more. Had the meter been owned by the city, it would have been immediately replaced by another meter. There would be no reason to return the identical meter removed.

The meters are the "cash regis ters" of a water works. As such they should be owned by the utility, not the consumer. Ownership by the utility, with the accompanying obligation of bearing the cost of repairs and renewals, will ultimately return several times the added expense through increased registration from the reduction in "unaccounted for" water.

There is no more reason why a water consumer should own the meter than that a car owner should buy his gasoline measured by the tank on his car.

Size of Meters

The utility rather than the consumer should make the decision as to the size of meter to install on a service. Analysis of the "unaccounted for" water in a number of plants indicates this decision is worth approximately 5 per cent in the water measured by the meters and sold. One of the most effective means of regulating the demand by consumers for oversize meters is by the inclusion in the rate schedule of a graduated service charge or graduated minimum charge. Theoretically this charge should vary approximately as the ability to use water, that is, as the area of the pipe opening. However, in actual practice it was shown in a recent paper by E. W. Moke (Journal A.W.W.A., June, 1940) that the increase is much less. Taking a ⅝ inch meter as unity, in average practice, the service charge for a 1 inch meter is approximately 60 per cent, a 2 inch meter 30 per cent, and a 4 inch meter but 17 per cent of the theoretical.

In the average city over 95 per cent of all meters are ⅝ inch and over 99 per cent are 1 inch and less.

Free Water?

There are various practices in municipal water plant operation with respect to the furnishing of so-called "free water." In some cities all water is billed and paid for. In others, water used by charitable institutions and other municipal departments is given a special discount, and in still others water is furnished for charitable and municipal uses without cost.

It is, of course, obvious that there is no such thing as "free water." It is just a question as to who pays for it. In equity all water should be sold at schedule rates regardless of the purchaser. If those responsible for municipal policies decide to give "free water," it should be metered in any event and the amount allowed free should be limited with a charge for all excess. Better yet, all such water should pay at some rate even though materially lower than the schedules rates. Public uses or "free water" usually take from 6 to 8 gallons per day per capita.

Consumer Complaints

All complaints should be recorded as to time, cause, locality, and corrective measures taken. Frequent review grouped by causes and localities has helped to avert major dissatisfaction.

Conclusion

In conclusion good management begins with good planning, requires a sound financial policy, alert, analytical administration of its own affairs and a knowledge of others, and the equitable allocation of the revenue requirements among the various classes of consumers.

THERE AIN'T THAT MUCH MONEY

(A Correction)

Dr. Hale, Director of Laboratories, N. Y. Dep't of Water Supply, somewhat excitedly, writes us as follows:

"In the November number of WATER WORKS AND SEWERAGE, page 537, the review of my paper before the New England Water Works Ass'n Convention, reported by H. A. Faber, there is a serious error in the comment in the third column answering question from Wiggin. The second sentence should read: 'Dr. Hale said that the annual budget for his *Division* was about $60,000, or nearly $2.50 per sample per year.'

"Such an error is too important not to be corrected.

"Very truly yours,
"FRANK E. HALE."
(Director of Laboratories)

(Dear "Doc:" Herewith the correction. We agree that 60 million is a lot of money —even for New York's laboratories.—Ed.)

WEST VIRGINIA SECTION MEETS IN HUNTINGTON

THE second annual meeting of the two-year-old West Virginia Section of A. W. W. A. and the 15th West Va. Conference on Water Purification were jointly held in Huntington, W. Va., October 24th-26th. The official registration was 168.

The three principal programmed topics were taste and odor elimination; experiences with polyphosphates in the control of scale, encrustation and corrosion; and an operators' trouble hour, revealing methods of correcting troubles experienced.

On the first afternoon Huntington's new Flood-Wall and the necessary stations for handling the city's sewage and storm waters during floods were inspected and a visit made to the filter plant and pumping stations of the Huntington Water Company, an American Water Works and Electric property. During the latter inspection it was learned how this company managed to keep operating during the 1937 "flood of floods" on the Ohio. In keeping going, one serious main failure was repaired under four feet of water with a Dresser Emergency Repair Sleeve, at a time when water supply failure seemed all but inevitable. Having heard this story and of other emergency measures developed by flooded water utilities, seemingly a good flood creates an excellent proving ground for maintaining and operating water systems damaged by war operations, sabotage, or any other catastrophic occurrence.

The Banquet

The Annual Banquet, attended by 150 members and guests, proved a happy occasion with Joe Buchanan, Vice-President of the Monongahela West Penn Public Service Co., Fairmont, W. Va., as toastmaster. Louis R. Howson, Vice-President of A. W. W. A., amongst the dignitaries at head-table, presented a brief picture of A. W. W. A. activities and the Association service to members and its remarkable sustained rate of growth since reorganization three years ago.

For this writer the Huntington meeting proved a sort of "Home Coming Week." This in view of the fact that much of his boyhood days were spent in Huntington which was where the "Enslow Clan" headed up and thrived on "Ohio River Straight"

The Presidents

(Retiring) *Wm. Kirchman, Sup't Filtration, Fairmont, W. Va.*

(Incoming) *A. L. Rhoads, Mgr., W. Va. Water Co., Bluefield, W. Va.*

before the Sanitary Engineering Division of the State Department of Health came into being.

T. R. Kendall, Engineering Editor of *"The American City"* magazine, was the principal dinner speaker. He discoursed on "Water Works I Have Met," including experiences in operating plants of the Panama Canal, which brought to this writer who

Hosts

(Huntington Water Corp.)

Max K. Jones, Manager, J. C. Edwards, Chemist & Ass't. Mgr.,*
*(*Chairman, Committee Local Arrangements)*

followed "Ted" Kendall in Panama some interesting recollections also. The speaker closed with suggestions for emergency preparedness in water works operation.

Harrington Honored

During the banquet the spotlight was thrown on one who shys away from such things, when the Committee on the Geo. W. Fuller Award, through Chairman A. R. Todd, made the popular announcement that John B. Harrington, Secretary of the Section and National Director, had been chosen as the member most deserving of the Fuller Award. The citation reads—"For outstanding work in advancing water purification in West Virginia and his leadership in the licensing of water works operators." Mr. Harrington, who has long served as Secretary of the W. Va. Conference on Water Purification, succeeded E. S. Tisdale as Director of the Sanitary Engineering Div. of the State Dep't. of Health.

Officers Elected

The following were unanimously elected to offices for the year ensuing:

Chairman

A. L. Rhoads, Manager, W. Va. Water Service Co., Bluefield, W. Va.

Vice-Chairman

Golden Underwood, Sup't., Water Dept., Parkersburg, W. Va.

Secretary-Treasurer

John B. Harrington, Director, Eng. Division, State Dep't. of Health, Charleston, W. Va.

(Mr. Harrington is also National Director of the Section.)

Trustees

J. C. Edwards, Huntington; Kenneth Waldeck, Sheperdstown; Prof. H. W. Speiden, Morgantown; Wm. Kirchman, Fairmont.

Technical Sessions

(Chairman Wm. Kirchman, presiding)

The opening paper constituted an interesting description of **"The New Huntington Flood Wall,"** by H. F. Falkner, Captain, U. S. Corps of Engineers.

This $10,000,000 project is one of the most important of 255 flood protection projects and 120 flood control reservoirs in the Ohio Valley Program of the Federal Government. For the wall surrounding the flood zones of the city, Huntington put up 16 per cent of the cost and the Federal Government's contribution was $8,400,000. The reinforced concrete wall, of cantilever design, has 23 port-gates equipped for water tight closing in three hours. Within the walled areas 13 pumping stations are required to discharge the sewage and storm waters of the city during floods. The wall and one of the largest pumping stations were inspected the same afternoon.

Captain Falkner commented that the entire Ohio Valley Program would involve expenditure of better than a billion dollars. In addition to flood control, regulation of the 120 reservoirs was expected to smooth out water quality fluctuations in the Ohio, and thus lighten the burden on water purification plants.

"The Huntington Water Works," by J. C. Edwards, Chemist, Huntington Water Co., Huntington, W. Va.

Mr. Edwards' paper, describing the Huntington system, more in detail described the purification and pumping facilities of 7.5 m.g.d. capacity. The Ohio River, in which no pollution enters closer than 100 miles above the city, is taken at three elevations, according to river stages. The original steel filters installed in 1890 are still in service along with the newer concrete units. The original steel coagulation tanks serve as pre-settlers (silt tanks), followed by a 4 hr. coagulation basin of concrete. Pre-chlorination and post-chlorination (5 to 8 lbs. m.g. total) yields a finished water of 0.35 p.p.m. residual. Alum is fed by a unique solution scheme, wherein a "basket" of alum is submerged the required amount in the flowing solution chamber to produce alum solution of constant specific gravity, allowing the rate of feed to be adjusted volumetrically. Or the control can be had by increasing or decreasing the density (degree of saturation) of the solution. Activated carbon is employed, and lime is added to suppress corrosion.

Experiences and Results with Tastes and Odors

"Some Cattlettsburg Experiences With the Big Sandy," by H. Cable Cramer, Manager, Cattlettsburg, Ceredo and Kenova Water Co., Cattlettsburg, Ky.

Mr. Cramer, in a highly humorous account, recited his experiences (troubles) with Big Sandy water served the three communities, two (Ceredo and Kenova) being in West Virginia. Mr. Cramer said that the telephone bell began ringing in November, 1939, and didn't quiet down for some days. To cope with the odor they started off mixing carbon with the alum; ended up by mixing in a little alum with the carbon. In the end, 14,770 pounds of carbon were used in combatting the oil tastes. They issued a "rush order" for Chas. P. Hoover and ended up by building a hay filter bed and providing aeration—the hay to absorb and adsorb the oil. In all it was 90 days before the customers stopped going to the drug store to pay their water bills, confided Mr. Cramer.

"An Experience in Crenothryx Control," by Edward Carroll, Preston County Health Department, Kingswood, W. Va.

At Arthurdale crenothryx in the mains had been responsible for complaints, due to anaerobic conditions

J. B. Harrington, Chief Engineer, W. Va. Dept of Health.
(Chosen for Fuller Award)

T. R. Kendall, Engineering Editor, "The American City."
(Banquet Speaker)

which resulted in foul tastes and black-water in the dead ends. Source of the crenothryx was traced to the deep wells. With ordinary chlorine-ammonia treatment no residual chlorine could be maintained in the pipe system.

Super-chlorination was tried, the "break-point" showing up at 3 p.p.m. The final practice is to apply 4 p.p.m. chlorine down in the wells and an additional 2 p.p.m. to the well pump discharge. The residual of 1 p.p.m. leaving the station reduces to 0.5 p.p.m. at the center of the system and 0.3 p.p.m. elsewhere. This scheme has corrected the crenothryx difficulties and residual can now be carried in the mains, as indicated, without ammonia.

"Experiences and Results at Indianapolis," by Neil Kershaw, Chief Chemist, Indianapolis Water Company, Indianapolis, Ind.

Mr. Kershaw revealed the taste and odor problem at Indianapolis to be principally from two causes. In summer, decomposing organic matter and algae at times; in winter, a more strictly chlorinous odor or taste, and also the winter bloom of Synura. Routine odor observations at 140° F. (the most critical temperature for odor intensity) are made at several points through the two filter plants, and as frequently as indicated desirable for the purpose of prompt detection and adjustment of treatment.

A source of major complaint are the odors in dead-ends of the system, termed by consumers "tarry" or "cabbage like." As to the cause, indications all point to bacterial decomposition of dead-end organic deposits. Relief becomes chiefly a matter of persistent main flushing at trouble points, and continuous summer bleeding where permissible. Certain complaints, however, had been traced to overheated water in contact with old faucet washers.

In routine testing, odor values are determined by the so-called "Short Parallel Method" in which dilutions are made in 25 per cent incriments. Such procedures had proved more practical than others and the speed of completing the tests was eminently desirable in routine plant control testing, or in evaluating experimental treatments and chemicals. For odor free water supply, the most satisfactory scheme had been to run plant effluent through two granular carbon contact units operating in series.

As to recent developments and plant operating experiences at Indianapolis, Mr. Kershaw stated that since the merits of super-chlorination carried beyond the so-called

A. R. Todd, Supt. Filtration, Wheeling, W. Va.
(Past Chairman of Section)

Perkins Boynton, Supt. Filtration Clarksburg, W. Va.
(Chairman Program Committee)

P. L. McLaughlin, San. Engineer & Chemist, W. Va. Water Service Co., Charleston.

"break-point" had been so effectively demonstrated at Indianapolis, the former method of ammoniation to prevent odor production attending pre-chlorination had been discontinued. Instead the present practice is to *destroy* the offending substances by super-chlorination, which seems to involve oxidation resulting from supersaturation of organic substances having an affinity for chlorine or hypochlorous acid. With this method super-chlorination of the water ahead of filtration had been effectively practiced, the control involving determination of the "break-point" on the chlorine demand curve for the water at hand. The total dosage involved is that found productive of the sudden dip in the excess chlorine curve—known as the "break-point"—and *in addition* 1 p.p.m. to insure the complete dosage effect so essential to assured destruction of the offending compounds. At indianapolis this method had involved chlorine dosage at times as high as 8 p.p.m. to the coagulated water. In routine testing for residual chlorine an effective check on the adequacy (sufficiency) of the dosage was had by parallel thiosulphate titrations for residual. Making the titration on a neutral sample in comparison with

(1) *Frank M. Offiutt, Jr., Operator, Williamson, W. Va., and W. H. Stepp, Operator, Kermit, W. Va.;* (2) *L. R. Howson, Chief Engr., and H. C. Cramer, Manager, Cattlettsburg, Kenova and Ceredo Water Co., Cattlettsburg, Ky.;* (3) *Jack A. Nuckols, Beckley Water Co., Beckley, W. Va., and Jas. A. Hyslop, National Tube Co., Pittsburgh.;* (4) *O. S. Carter, Supt. Cedar Grove, W. Va., and C. H. Turner, "Calgon" Inc., Charleston, W. Va.;* (5) *Hugh W. Hetzer, Asst. Engr. W. Va. Water Service Co., Charleston and his "Dad" Mentor Hetzer, Mgr. Moundsville Water Co., Moundsville, W. Va. (Like Father, like Son.)*

the same sample acidified after adding the iodide, the two results must check within practical limits of the ideometric titration. If the acidified sample yields a higher residual the indication is that chloro-substitution products are responsible and therefore complete "chloridization" (oxidation) has not been attained. The dosage is accordingly deficient and is promptly raised until the acid and neutral tests check. (A similar scheme employed at other points involves the factor of time in maximum color development with ortho-tolidin. If the maximum color development, at 20° C. or above, is not realized within one minute of reagent contact the chlorine dosage is usually deficient.—Ed.)

Mr. Kershaw also recounted experiences with certain algae conditions wherein a combination of 3 p.p.m. copper sulphate, fed simultaneously (possibly through a common hose line) with 3 p.p.m. chlorine, had proved a more effective remedy than either employed singly. At times this combination of cupro-chlorination is indicated and employed with good effects both ahead of the slow-sand and the rapid filters. In no event is ammonia added ahead of the filters, as formerly, but is held for application to the plant effluent as a residual chlorine fixation method.

"Super-Chlorination," by H. A. Faber, Research Chemist, The Chlorine Institute, New York, N. Y.

(Mr. Faber's paper did not follow the Indianapolis paper, but we are inserting the record of it at this point because of the closely allied nature of the discussion.)

Mr. Faber brought up to date some further considerations and developments in super-chlorination, wherein the "break-point" method had been found the most effective known "measuring-stick" (not available in earlier super-chlorination practices, some successful and others not), to detect when truly efficacious super dosages of chlorine were being employed. He cited the disappearance of so-called free ammonia at and just beyond the effective "break-point," and also the effect of increased ammonia in creating a more decided "break-point." In fact, ammonia had been actually added to some waters for the purpose of more clearly establishing a more defined "break-point," for the purpose of dosage control and efficacy of the method. Then, too, minor amounts of ammonia (less than 1/10th the chlorine residual) applied to a super-chlorinated water actually served as a dechlorination procedure; however, with larger amounts the residual is converted into tasteless and persistent chloramines reaching far out into the pipe system. Mr. Faber also cited the experimental work of Dr. Levine (Iowa State College) which revealed that ammonia attack and dissipation by chlorine always preceded the most effective bacterial kill. Likewise, observations had been made of the efficacy of super-chlorination in reducing materially the oxygen demand of such highly organic liquids as cannery wastes, all of which pointed to the oxidation theory in explaining the destruction of ammonia compounds and taste producing bodies.

Mr. Faber named the case of Newport, R. I., in which the raw water is high in organic extracts and color but very low in ammonia. No sharp "break-point" could be detected. Also of considerable interest was the fact that the raw water after chlorination with 17 p.p.m. dosage had retained 15 p.p.m. after aeration but had no taste, *not even a chlorine odor.* With reduced dosages the taste was decidedly objectionable.

A. R. Todd, Sup't. of Filtration, at Wheeling, W. Va., in a highly interesting and revealing discussion, set forth the finding of as many as three distinct "break-points" on the raw Ohio River water at Wheeling. In effectiveness the optimum chlorination result is secured when the river water is high in ferrous sulphate and has a pH of 4.7. The addition of lime to the raw water increases the chlorine requirement for pre-chlorination, which also oxidizes the ferrous sulphate to materially improve coagulation. In the natural production of "chlorinated-copperas," the lowered pH at 4.2 due to chlorination is, therefore, boosted later with a minor lime dosage. In taste prevention, the withholding of lime had been found an essential procedure. In practice the chlorine requirement runs from 9 to 62 lbs./m.g. Because of the economy of natural iron coagulant in the water, the use of one ton containers, the discontinuance of ammonia, and the taste improvement, the overall cost had proved attractive.

Mr. Todd revealed that in making "break-point" determination he had materially simplified the procedure for use in plant routine. Only three samples are employed in the test series. The equivalent of 150 lbs./m.g. chlorine dosage is applied to all three. The "break-point" dosage is the difference between the 150 lbs./m.g. added and the residual found. The method, said Mr. Todd,

(1) *H. D. Mendenhall, Badger Meter Co., Huntington, and H. J. Weekley, Filtr. Supt., Grafton, W. Va.;* (2) *A. O. Scott, Filtr. Supt. West Union, W. Va. and E. E. Riddle, Operator, Pennsboro, W. Va.;* (3) *J. W. Chapman, Supt. Hurricane, W. Va. and Floyd Smith, Supt., Wayne, W. Va.;* (4) *Mayor J. E. Billups, Hurricane, W. Va. and T. L. Young, Mgr. Chester Water Co., Chester, W. Va.;* (5) *George Riffee, Supt., Shinnston, W. Va. and Fred J. Durner, Mathieson Alkali Wks., Pittsburgh.*

checks with plant operation results at least it does on the Wheeling water.

In reply to questions, Mr. Todd stated that in the tests the dosage should be such that not less than 100 lbs./m.g. (12 p.p.m.) residual is found after the contact period. The standard chlorine solution used is made from "Chloramine-B," which is a very stable product supplied by The Solvay Co. of Syracuse, N. Y.

Beckley to Have All-Steel System

"The Proposed Water Supply System of Beckley," by W. A. Kelly, Consulting Engineer, Beckley, W. Va.

Mr. Kelley described the additional surface supply system to be built for the Beckley Water Co., as a supplement to the existing well supply of this West Virginia city, which has more than tripled in population between 1920 and 1940. The filter plant, referred to as an all-steel plant, will have twin circular steel coagulating basins, with steel spiral baffles, erected by the Pittsburgh Des Moines Steel Co., who is also supplying the four circular steel filters of 0.5 m.g.d. each to be enclosed in a brick building.

The 52,400 ft. Dresser coupled gravity main of 14 in. diameter steel pipe is being supplied by the National Tube Co., and protected by the Hill-Hubbell Co. coating, lining and wrapping process, applied under the new A. W. W. A. Specifications. A steel storage tank of 1 m.g. capacity is being constructed to permit the more economical operation of the 2 m.g.d. filter plant on a one shift basis. Incidentally, the 14 in. main has a 3 m.g.d. capacity for ultimate needs, and the impounding reservoir stores 400 m.g. of soft raw water. So, Beckley should not lack for a drink of good cool mountain water for some years to come.

"Shatter-proof Mains," by W. F. Horsch, Sales Engr., Hill, Hubbell and Co., Cleveland, Ohio.

Due to illness, the author could not appear, but his paper was ably presented by R. J. Young of the same company. Mr. Horsch's paper reviewed something of the satisfactory history of steel water mains when installed under suitable conditions and properly maintained. He listed Boston, New York, Detroit, Washington, Los Angeles, San Francisco, and Chicago as the larger cities favoring steel pipe for arterial and feeder mains which the author said was because of their shatter-proof nature, and the jointing with bacteria free flexible couplings. Mr. Horsch then discussed the advantages of such "give and take" couplings with their leak-proof rubber gaskets next to the water instead of trouble making dirty jute to harbor bacteria and give the supply an unsavory record.

Kenneth L. Waldeck, Supt., Potomac Light & Power Co., Shepherdstown.
Neil Kershaw, Chief Chemist, Indianapolis Water Co., Indianapolis.
R. J. Young, Engr. Hill, Hubbel & Co., Cleveland, O.

H. W. Speidin, Prof. Civil Engr. Univ. of W. Va., Morgantown.
W. D. Kelley, Consulting Engr., Beckley, W. Va.
W. W. Hodge, Prof. Chemical Engineering, Univ. of W. Va., Morgantown.

The problem of soil corrosion and interior attack by aggressive waters had now been solved by modern protective coatings, applied in accord with recently issued A. W. W. A. Specifications. He then described the Hill, Hubbell Process of bituminous lining and coating, the latter being protected against chipping in handling and bruises in laying or soil pull after laying, by a spiral wrap of tar-impregnated felt. The tough outside coating and wrapping of the Hill, Hubbell Process, he said, measured ⅛ inch thickness.

In further listing the advantages of steel pipe for mains, Mr. Horsch said that added to the inherent toughness and strength there is a decided handling and laying economy (between 15 and 25 per cent) by the use of long lengths and the ease and quickness of jointing with rubber gasketed flexible couplings.

"Cathodic Protection of Steel Structures," by E. H. Ingle, President, Electro-Rustproofing Co., Dayton, Ohio.

Mr. Ingle reviewed the basic principles of the Cathodic Process of inhibiting corrosion of submerged metals, by creating a trickle flow of direct current from the water into the metal face to counter the natural tendency of ions (and metal) to leave the metal face and enter the water.

He then went into a description of the two important elements in the system—the A-C to D-C Converter (rectifier) and the anode from which the D-C current travels through the water (electrolyte) to the opposite pole of the cell, in this instance the metal faces being protected. He briefly described the "Type A" higher grade and long-lived Westinghouse Copper Oxide Rectifier of 1 Amp. each, which after a 10-year service showed no indication of weakening. Then there was the "Type B" unit of lower first cost. It is known as the Copper Sulphide Rectifier and good for 14 months to 2 years of service. These 3 Amp. sulphide units however have not the sustained efficiency of the 1 Amp. Copper Oxide units.

Concerning the anodes, there were two varieties—stainless steel (18-8) and the less expensive graphite or carbon. In three years there had not yet been any anode replacement where stainless steel is employed, except in acid or sulphide waters. When replacement becomes necessary, he said, it is the policy of the

(1) "Phil" Kavanagh, Wallace & Tiernan Co., Roanoke, Va.; (2) E. F. Twomey, Morris Knowles Engrs., Pittsburgh.; (3) Dean McCrory, Pa. Salt Mfg. Co., Pittsburgh; (4) "Joe" Gilbert, Link-Belt Co., Philadelphia; (5) C. N. Davis, Supt. Fayetteville, W. Va.; (6) Earl Johnson, Distr. Mgr. Wallace & Tiernan Co., Pittsburgh. (Secy-West Pa. Section) (7) D. M. Tyler, Supt. Elkins, W. Va.; (8) Charlie Gregg, Distr. Mgr. Dresser Mfg. Co., Bradford, Pa.; (9) R. H. Beck, Pittsburgh—Des Moines Steel Co., Pittsburgh.

(1) W. H. Pressing, V. P. and Sales Mgr. Rusta Restor Corp., Fremont, Ohio, and Frank M. Offutt, Sr., Supt., Williamson, W. Va.; (2) P. W. Tingley, Supt. W. Va. Water Service Co., Montgomery, W. Va. and Julian Fawcett, Supt., Marlinton, W. Va.; (3) Groups at the Huntington Filtr. Plant (Kelso at right); (4) Perkins Boynton, Supt. Filtr., Clarksburg, W. Va. and E. A. Morgon, Asst. Supt., Wellsburg, W. Va.; (5) "Al" Scheinert, Rensselaer Valve Co., Pittsburgh, and J. S. Hugart, W. Va. Water Service Co., St. Albans, W. Va.

Company to do the job at actual cost. The expense should not exceed $8 to $10 annually for electrode depreciation.

In reply to a direct question as to which combination of rectifier and anode was to be recommended as overall the most economical over a period of years, Mr. Ingle said that if the money is available the wise investor would select the Westinghouse Oxide Rectifier and the stainless steel anode. However, since each installation is engineered individually conditions might warrant a different combination and thereby alter his blanket recommendation.

In reply to a second question as to cost of painting vs. Cathodic Protection, Mr. Ingle cited the recent case of Dubuque, Ia., wherein cleaning and painting of a tank was estimated at $5,000. The Cathodic system had been supplied and installed for $1,500 less, not to lose sight of the inconvenience of having had the tank or standpipe out of service during the renovation.

Experiences with Hexametaphosphate

"Experiences on the C. & O. Ry. System" were reviewed by H. B. Dale, Chemist, C. & O. Ry., Huntington, most of which have on more than one occasion been presented before meetings and reported in this magazine. In preventing scale deposition in hot water lines 2 p.p.m. of hexametaphosphate, marketed under the trade name "Calgon," had proved all that is required. If old scale is to be honeycombed and disintegrated a considerably larger quantity is required, namely, 5 p.p.m. or better. One of the most impressive benefits from the application had been found in the multi-tube boiler water preheaters on locomotives. Former practice had been to clean these units at 10-day intervals with hydrochloric acid. With an application of 5 p.p.m. of "Calgon" to the tender water these laborious and expensive cleanings had been reduced from 36 per year to 4 per year, and represented quite an item on a large railroad system.

"Experiences at Nitro, W. Va.," by P. L. McLaughlin, Sanitary Engineer, West Virginia Water Service Co., Charleston, W. Va.

Mr. McLaughlin's paper, read by Gilbert Kelso, constituted a progress report covering a study made of hexametaphosphate and lime treatment to protect a recently cleaned transmission main almost 30,000 feet long. Cleaning of the line raised the coefficient from 49 to 130 for the 10-inch main. In an attempt to hold this satisfactory coefficient, lime treatment to produce stability at $CaCo_3$ saturation—resultant pH of 8 to 8.5. In spite of this, rusty water appeared at consumers' taps almost 6 miles away where iron content of 3 p.p.m. and better was found. In an attempt to remedy this condition "Calgon" application was started in conjunction with the lime treatment. The water had an average hardness of 62 p.p.m. and alkalinity of 30 to 40. Calgon treatment was begun at 10 p.p.m., trimmed to 5 p.p.m. and soon after to 1 p.p.m., and thus continuously over a period of 6 months.

The results during the period had been puzzling to say the least. There was still a pH drop of roughly 1 unit through this 6 mile main; a baffling CO_2 pick-up of 16 p.p.m.; and the iron content did not reduce appreciably. Then the quality of water changed and total alkalinity dropped precipitately from 40 p.p.m. to less than 10 p.p.m. Calgon treatment was discontinued and lime increased to secure a pH of 9.0 and better. With this change in water quality the iron content began diminishing; the alkalinity of the filtered water crawled slowly back to 30 parts and a pH of 9.0 to 9.1 maintained. The iron content reached a low of 0.1 p.p.m. and seemed fair to remain low without the aid of "Calgon." However, when the alkalinity of the filtered water again exceeded 30 p.p.m., although the pH of 9 to 9.2 was maintained (no Calgon), the iron content has been on the increase again. An interesting disclosure (probably significant) was the fact that during the minimum of iron pick-up through the 6-mile main the pH drop was the least noted at any time.

As Mr. Laughlin pointed out, the full understanding of the observations is not at hand, but the results justify the attention called to them in his progress report. It is apparent that neither lime treatment to $CaCO_3$ equilibrium nor Calgon were effective as measures of suppressing corrosivity and tuberculation sufficiently to maintain the coefficient values of the newly cleaned main. Possibly a higher dosage of Calgon would have done the job, but to prove or disprove as much remains for another day when this main is cleaned again. Perhaps more than any other one thing that the Nitro experiences demonstrated is the fact that protective pipe linings remain the one most dependable means of tuberculation and red water control.

Owen Rice, Research Engr., Calgon Inc., Pittsburgh, said that the

(1) C. E. Kelley, Cons. Engr. Beckley, W. Va. and A. C. Harvey, Supt. Beckley Water Co.; (2) A. R. Todd, Supt. Filtration, Wheeling and Mentor Hertzer, Supt. Moundsville Water Co.; (3) "Art" Welch, Ind. Chem. Sales Co., N. Y. City.; P. L. Laughlin, Chemist, W. Va. Water Service Co., Charleston and A. A. Kramer, L. A. Salomon & Bro., New York.; (4) V. S. Stockwell, Supt., Richmond, (W. Va.) Water & Light Co. and S. W. Morris, Supt., Milton, (W. Va.) Water Co.; (5) R. F. Hall, Supt. W. Va. Water Service Co., East Rainelle, W. Va. and Frank L. Sattes, Belle Alkali Co., Belle, W. Va.

Nitro case was possibly one in which the corrosion rate proved too rapid for effective phosphate plating with a dosage as low as 1 p.p.m. The fact that no phosphate was found at the end of the line (even after 6 months of application) was in itself indicative, although the great length of main meant that the plating had not progressed rapidly enough (or far enough to "keep ahead of the wolf," so to speak. Where the observed increase in CO_2 came from in this newly cleaned main was truly puzzling. (What puzzled more people than the fact that 1 p.p.m. of Calgon hadn't been sufficient for the rapidly corroding main was the fact that the lime treatment had proved so ineffective in itself.—Ed.)

Trouble Period

In this hour operators had their turn of relating problems faced and troubles experienced and methods of correction.

"Problems and Remedies at Shepherdstown," by Kenneth Waldeck, Operator, Potomac Light and Power Co., Shepherdstown, W. Va.

Mr. Waldeck told of a broken raw water suction line into the Potomac River and its repair with 8-ply rubber sleeves; of algae choked filters and relief by filter bed "fluffing" by opening and closing the wash valve. Another problem was to prevent a main extension of 2-in. steel (black iron) pipe from producing red water. The marble test revealed a pH of 8.6 necessary and lime application boosted above this point did the job. To read meter dials through a register glass covered with dew or sweat constituted a problem, necessitating removal of the tops in many instances by meter readers. Mr. Waldeck exhibited a meter glass wiper, on the principle of a wind-shield wiper, which he had developed. It consisted of an ordinary bobbie-pin that the ladies use as hair pins. A notch cut with a file in the edge of the glass gives clearance for the pin. The prong beneath the glass is wrapped with friction tape one layer thick, and a twist of the upper (outside) prong swipes clear the underside of the glass.

"High Iron Content at Princeton," by Nickey Leshkow, Operator, W. Va.

Mr. Leshkow told of an expedient tried to increase yield of a Princeton Well. Surface water was added to an abandoned well 300 ft. from that in use. Fateful result: The iron content in the used well jumped to 28 p.p.m. just 3 hours after the ground water feeding was commenced.

Roy C. Harbert, Supt., Lumberport, W. Va.

H. K. Gidley, Asst. Engr., W. Va. Dept. of Health, Charleston

Nick Leshkow, Operator, W. Va. Water Service Co. Princeton.

Crenothryx growths and other filter bed choking growth had been a problem. Ten (10) p.p.m. $CuSO_4$ did not destroy them, neither did 75 p. p.m. On the other hand, 30 to 60 p.p.m. "Perchloron" (high test hypochlorite of Penna. Salt Mfg. Co.) had turned the trick when allowing the solution a 10 to 12-hour contact in the filter. This method, and more recently the Palmer Filter Bed Agitator, had been an effective remedy.

Virginia Harris, State, Dept. of Health (Secretary to the Secretary)

R. G. McCall, Asst. Engr. State Dept. of Health, Charleston.

Wm. S. Staub, Engr., Operations & Maintenance, W. Va. Water Service Co., Charleston.

"Flood Water Experiences at Hinton," by M. H. Martin, Sup't., W. Va. Water Service Co., Hinton, W. Va.

The flood of August 15th which put many water plants out of service because of the rapid rise of small streams, put 6 ft. of water in Mr. Martin's boiler room and 4½ ft. in his filter room. He told of getting the plant back into service 4½ hours after the water receded. Even with water rationing, the city was without water one day in consequence.

"Early Water Supplies of West Virginia," by H. K. Gidley, Assoc. Engr., W. Va. State Dep't. of Health, Charleston, W. Va.

Mr. Gidley's interesting compilation of public water supply history in West Virginia revealed the famed medicinal springs to be the oldest public supplies. Then came the water dispensing carts along the Ohio.

Of the municipal supplies, Wheeling had the earliest (Aug. 1834). The system was financed by lottery. Steamboat boilers were used to run the pumps. At that time coal was selling for 87 cents a ton. A 14-in. diameter iron pipe 1,000 ft. long was the main artery. In 1839 the plant proved inadequate; in 1918 the river water was chlorinated; in 1925 the present plant was built. It represents the largest in the state.

The second oldest supply was that of Martinsburg which made use of cement-lined wrought iron pipes, abandoned when the present plant was built in 1903.

The first rapid filters were at Huntington (1898) but coagulation was not employed until two years later. The Huntington Water Company dates back to 1886. Chester, W. Va., has made use of infiltration galleries along the river banks for 40 years. Parkersburg also has a similar gallery, now held in reserve. It proved of considerable value in the 1936 and 1937 floods.

Today there are 431 public water supply systems in West Virginia serving 460 communities.

Other Papers

We regret that space does not permit adequate reporting of the following papers:

"Progress in Abatement of Stream Pollution by Steel Mill Wastes," by W. W. Hodge, Prof. of Chemical Engineering, West Virginia University, Morgantown.

"Recent Pollution Studies of the State Water Commission," by K. S. Watson, Chemical Engr., State Water Commission, Charleston.

"Water Bacteriology," by E. A. Martens, Assoc. Prof. of Bacteriology, West Virginia University, Morgantown.

(1) *At the Huntington Filtr. Plant.*; (2) *Inspecting Huntington's New* $10,000,000 *Flood Wall and Protection Works*; (3) *Group at the Filter Plant, (Waldeck, Davis, Topham, Justus and Moses)*

NINTH GEORGIA WATER AND SEWAGE SCHOOL

Sets New Mark with 307 Sup'ts. and Operators Attending

THE Ninth Annual Georgia Water and Sewage School was held in Atlanta October 16, 17, 18 and 19. The total attendance of 343, exceeding that of any previous year, was composed of 307 superintendents, operators, municipal and other public and industrial officials and 36 manufacturers' representatives. The large registration signifies the important place that this school occupies in the Georgia plan of providing stimulus for efficient operation of water and sewage plants and swimming pools. The school also permitted representatives of communities not yet adequately provided with modern faciltiies to gain practical ideas for planning local water and sewerage programs.

Award Recipients

R. T. Littlefield, Supt.
Jesup, Ga.

J. S. Harris, Operator
Atlanta Filter Plant

W. L. Huckeba, Supt. Filtr.
Carrollton, Ga.

(*"For Outstanding Accomplishments in the Field of Water Works and/or Sewerage During the Year" were Messrs. Littlefield and Huckeba cited. To Mr. Harris went the F. J. MacMullen Memorial Award—"For the Most Valued Service Rendered the Association During the Year."*)

The Annual Short School, sponsored and conducted jointly by the Georgia Water and Sewage Association, the Georgia School of Technology, and the Georgia Department of Public Health, was held in the classrooms of the Georgia Tech. The instruction schedule was planned by a committee representing the three sponsoring agencies. Instructors were supplied by these organizations and supplemented by qualified persons selected from allied professional fields. Instruction was conducted by the lecture-demonstration method, to which was added informal discussion and plant inspections.

(For this report and photographs we are indebted to W. H. Weir and G. R. Frith of the Ga. Dept. of Public Health, and associates.—Editor.)

Presidents and "Wheel Horse"

Clark W. Jones, Supt.
Dalton, Ga.
(Retiring President)

H. A. Wycoff, Prof. P.H. Eng.
Georgia School of Technology
(Voted Life Membership in Assn.)

Geo. H. Sparks, Supt.
East Point, Ga.
(The New President)

Sewage plant operation and swimming pool maintenance were given increased emphasis in the instruction schedule. The similarity of principles involved made it possible to combine discussion of these with water purification subjects thus effecting a considerable saving of time and eliminating duplication in teaching effort. A special class was conducted for those attending for the first time, and enabled the men in this group to adjust themselves more readily to the subjects under study by the advanced group.

Full Day to Plant Inspections

One day was spent in visiting interesting plants in Northwest Georgia. An impressive motorcade of over sixty automobiles transported those attending the School on a one-hundrded fifty mile trip, returning in the evening to Atlanta.

The first stop was at Marietta to inspect the new West Side Sewage Treatment Plant and at the municipal swimming pool. Stopping next at the Tubize Chatillon Corporation, the preparation of water for rayon manufacture was observed. An interesting part of this plant inspection was the opportunity to see the careful laboratory control and system of record keeping involved in the production of industrial water of the highest grade from the turbid Oostanaula River.

The motorcade arriving in Rome at noon was greeted by representatives of the Chamber of Commerce and the City Commission. These two bodies were hosts at a barbecue served to the group in the municipal pavilion overlooking the city and the industrial vicinity.

Following lunch the motorcade continued on to the recently completed Rome water plant. Here was demonstrated the new municipally owned filtration plant taking raw water from the Oostanaula River and serving Rome's population of approximately twenty-five thousand. Complete laboratory control and modern equipment characterize this plant. Many details of plant operation and control were here demonstrated.

Leaving the Rome plant the motorcade separated into two sections, one going to the Berry School campus for further water plant inspection and the other to Cedartown for sewage treatment plant operation observation. The group which visited Cedartown inspected the new sewage plant to observe the treatment of textile dye wastes combined with domestic sewage. While this was the longest and most extensive inspection trip ever undertaken by the Georgia Water and Sewage School there was unanamity of opinion that the day was most profitably spent.

Army Portable Water Purification Unit Demonstration

Through authorization of the Fourth Corps Area Engineer Office one of the new portable field water purification units was sent from the 4th Engineer Regiment at Fort Benning for demonstration. The unit, consisting of intake pump, coagulant and chlorine feeders, pressure filter, and canvas reservoir, is capable of clarifying and sterilizing fifteen gallons per minute. This type of unit is used for a field water distributing

Officers

Porter Enloe, Supt.
Clayton Treatment Wks., Atlanta
(Sewage Wks. Federation Director)

G. R. Frith, Asst. Engr.
Ga. State Dept. of Health
(Sewage Wks. Federation Director)

H. E. Whelchel, Supt. Filtr.
College Park, Ga.

point for a regiment or similar body of troops and being in several parts of light weight is capable of rapid movement and quick assembly.

Examinations and Certification

Written examinations were conducted for Class A, B and C Water Certificates and Class C Sewage Certificates. The number of candidates taking examinations in the several classifications were as follows: Class A Water 3, Class B Water 10, Class C Water 22, and Class C Sewage 22. Examinations for sewage plant operator certification were held for the first time this year. Certification of water plant operators has been in effect for several years and the extension of this program into the sewage field is a logical step in directing public attention and appreciation to the operation of sewage plants. Examinations for Class B Sewage Certificates will be held next year and in ensuing years in all classifications including Class A.

Ga. W. & S. Assn. Banquet and Business Meeting

The school is held each year concurrent with the annual meeting of the Georgia Water and Sewage Association. The evening business meeting and banquet provided the occasion for transacting the business affairs and electing officers of the Association. It was also the fun spot of the school, enlivened by "toasting and roasting" during a splendid dinner.

Clark W. Jones, Superintendent of Water, Dalton, President of the Association, presided at the dinner and Paul Weir, Atlanta, Secretary, served as toastmaster. The following were recipients of awards for meritorious service or outstanding accomplishments in the water works and sewerage field during the year. W. L. Huckeba, Superintendent of Filtration, Carrollton, and R. T. Littlefield, Superintendent of Water Works, Jesup, received certificates of award for outstanding operation of local plants and systems. These awards carry subscriptions to a water works periodical. J. S. Harris, Operator, Atlanta Filtration Plant, received the Frederick J. MacMullin Memorial Award carrying affiliate membership in the American Water Works Association for service in preparing issues of "Drippings from the Georgia Faucet." Honorary Life Membership in the Georgia Water and Sewage Association was conferred on H. A. Wyckoff, Biology and Public Health Engineering Departments, Georgia School of Technology.

Bruce Hamber, Supt., Rome, Ga. (Luncheon Host)
Dr. A. P. Black, Head of Univ. of Florida's Chemistry Dept., being "interviewed" by Neptune's George Cissna of Atlanta.

W. H. "Bill" Weir, Assoc. Director, Engineering Div.—Ga. Dept. of Health. (One of the prime-movers of Georgia's note-worthy Water and Sewage School of which he is justifiably proud.)

Officers Elected

The following were elected officers of the Association for the ensuing year:

President—Geo. H. Sparks, East Point, Ga.

First Vice President—H. E. Welchel, College Park, Ga.

Second Vice President — W. H. Weaver, Decatur, Ga.

Secretary-Treasurer—Paul Weir, Atlanta, Ga.

As Members Board of Control, Sewage Works Federation — Porter Enloe, Atlanta, Ga.; G. R. Frith, Atlanta, Ga.

(1) *R. B. Du Pre, Genl. Mgr., Marietta, Ga.;* (2) *H. F. Wiedeman, Wiedeman & Singleton, Engrs., Atlanta;* (3) *D. H. Hurst, Supt. of Sewers and Treatment Works, Tipton Ga.;* (4) *H. H. North, Chmn. Water and Light Commission, Newnan, Ga.;* (5) *L. W. Handley, Chief Operator, La Grange, Ga.;* (6) *L. J. Smith, Supt., Ackworth, Ga.;* (7) *J. M. Perryman, Sales Engr., R. D. Cole Mfg. Co., Newnan, Ga.;* (8) *B. L. Coburn, Supt. Water and Lights, Fitzgerald, Ga.;* (9) *A. S. Johnson, Supt. of Water, Norcross, Ga.;* (10) *G. M. George, Supt. Water and Light, Thomaston, Ga.*

Instruction Schedule

The class sessions with subjects and instructors are shown in the following schedule:

Wednesday, Oct. 16.

Addresses of Welcome—Dr. M. L. Brittain, President, Georgia School of Technology. Dr. T. F. Abercrombie, Director, Georgia Department of Public Health.

Explanation of Course—W. H. Weir, Assoc. Director, Eng. Div., Georgia Department of Public Health.

"Maintenance of Elevated Tanks"—W. J. Whaley, Supt. of Water Works, Winder. John M. Perryman, R. D. Cole Manufacturing Co., Newnan. Edwin S. Woodward, Aluminum Co. of America, Atlanta. Logan Beckley, Jr., Rusta-Restor Corp., Atlanta.

"Utilization of Existing Public Water and Sewer Services"—D. C. Fowler, Georgia Department of Public Health. H. M. Renner, City Manager, Cedartown. R. B. DuPre, City Manager, Marietta.

For the Basic Water Group

"Basic Water Supply and Purification"—H. A. Wyckoff, Georgia School of Technology. N. M. deJarnette, G. R. Frith, W. H. Weir, Georgia Dept. of Health.

For the Advanced Water Group

"Recent Trends in Chlorination"—W. L. Huckeba, Supt. of Filtration, Carrollton. L. L. Jacobs, Assistant Supt. of Water Works, Newnan. M. E. Henley, Wallace and Tiernan Co., Atlanta. A. P. Black, Univ. of Florida, Gainesville, Fla.

"Indutrial Water Problems"—Clyde Angle, Tubize Chatillon Corporation, Rome. Earl Thompson, Supt. of Filtration, Thomaston. Dr. Glenville Giddings, Atlanta. H. F. Wiedeman, Wiedeman and Singleton, Eng'rs., Atlanta.

Moving Picture—"Behind the Water Tap" (In Technicolor)—R. W. Haywood, Jr., Industrial Chemical Sales Corp., Gastonia, N. C.

Thursday, Oct. 17.

Field Inspection Tour—(Full day—150-mile trip covering five plants.)

Friday, Oct. 18.

"Swimming Pool Design and Operation"—G. D. Newton, Sanitary Engineer, Fulton County Health Dept, Atlanta. J. E. Robertson, Gainesville Water Dept. Lewis Simonton, Griffin Water Dept. W. L. Avrett, Georgia Dept. of Health.

"Chemistry Lecture"—J. L. Daniel, Dept. of Chemistry, Georgia School of Technology.

"Operation and Testing of Pumps"—J. L. McDonald, Engineer, Sea Island Co., Brunswick. W. F. Buchholz, Engineer, U. S. Penitentiary, Atlanta. Roland B. Hall, Burford, Hall and Smith, Eng'rs., Atlanta.

Water Round Table

(Clark W. Jones, Presiding)

"Distribution System Samples"—Paul Weir, Supt. Filtration, Atlanta Water Dept.

"Coagulation of Low Turbidity Water"—Mack A. Parks, Berry Schools, Mount Berry.

"Tastes and Odors"—Dr. S. H. Hopper, Biology and Public Health Depts., Georgia School of Technology. Carl Alexander, Rome Water Dept., Rome.

"Maintenance of Filters and Filter Equipment"—H. G. Wylds, Augusta Water Dept. F. M. Hull, Columbus Water Dept.

Sewage Round Table

(G. R. Frith, Presiding)

"Operation of Sludge Pumps"—Lewis Simonton, Sewer Dept., Griffin. D. H. Hurst, Supt. of Sewage Treatment, Tifton.

"Sewering Low-Cost Housing"—B. L. Coburn, Supt. Water, Light and Sewer Dept., Fitzgerald.

"Filter Fly Control"—Henry Knapp, Sewer Dept., Atlanta.

Georgia Water and Sewage Association Banquet and Business Meeting.

"Sabotage—Plant and Utility Protection"—R. G. Danner, Chief, Atlanta Office of the F. B. I.

Saturday, Oct. 19.

"Customer Relations"—Blaine Walker, Atlanta Water Dept.

"Service Meters—Maintenance and Testing"—W. M. Rapp, Supt. Construction and Distribution, and Otis D. Harris, Foreman Meter Repair Shop, Atlanta Water Department.

(This proved to be Mr. Rapp's last lecture and demonstration, of which there have been many of real value, for he passed away on Nov. 19—only one month later.—Ed.)

A Closing Treat

Upon completion of the final school session and examinations, those in attendance were guests of President M. L. Brittain and the Athletic Association of the Georgia School of Technology at the Georgia Tech-Vanderbilt football game.

ALEXANDER BELL IS DEAD

But His Spirit Will Live With All Who Knew Him

"Alex"

Alexander Bell, star Wallace and Tiernan salesman who earned his spurs, to become Western Manager for this important company, passed away at his Woodside, California, country home near San Francisco, on December 10th.

Born in Milwaukee, Wisconsin, May 4th, 1882, he was 58 years young when he died. We say *young* because "Alex" Bell, never lacking in vim and vitality, was of the sort that refuses to grow old. He did things; and kept busy at it.

For the most part, "Alex" Bell's education was gotten through the school of experience. We have little knowledge of his history prior to the World War when he saw service overseas as an officer on a destroyer of the U. S. Navy. On shore leave he got to know something of a Wallace & Tiernan chlorinator and at the close of the war decided that he would like to take a whirl at selling in the chlorinator field. The rest of the story is as nearly as we can recall it of his own telling.

He went to Newark in 1919 and rang W.&T.'s front door bell, asked to see the sales manager and got an interview. "Sorry, Mr. Bell, that we are fresh out of salesmen's positions just now, but keep in touch with us," concluded that interview. The next time that Mr. Sales Manager and Mr. Bell met was when the boss telephoned the shop for the best mechanic available, needed for a difficult rush job in the field. Through the office door a few minutes later walked "Alex" Bell. "I asked for a mechanic; weren't you here a short time ago looking for a job selling?" "That's right, Mr. Orchard, but since I *am* a mechanic when I left your office I merely went around to your side door and they put me to work—so now you've got both a mechanic and a salesman; which do you need most right now?"

To make the story short "Alex" Bell on that rush job (and a tough one it turned out to be) proved that he was a salesman as well as a mechanic. He had won his spurs, and it was not long after that he was pulled out of the shop and sent out to California to open a W. & T. Pacific Coast Office in San Francisco. What he did with this opportunity is a "success story" of the West Coast. He proved to be a genial diplomat as well as a master salesman, and won friends for himself and W.&T. in every town and hamlet on the West Coast; built up his territory to support offices in Los Angeles and Seattle, and eventually was made Western Manager.

"Alex" Bell was active in the organization of the California Section of A.W.W.A. in 1920; and has been prominently connected with it ever since. In 1938 he had the distinction of being the only "peddler" to ever be elected president of the California Sewage Works Association.

Alexander Bell is a name long to be remembered on the Pacific Coast for its possessor had probably more acquaintances and as many friends in the West as any man. His bosses became his best friends, and that in itself is a tribute to both.

FERTILIZER AND FERTILITY VALUE OF SEWAGE SLUDGE*

DR. WILLEM RUDOLFS[1]
N. J. Agricultural Experiment Station
NEW BRUNSWICK, N. J.

THE use of various types of sewage sludge as sub-grade fertilizer or soil builders has been advocated for many years. Enthusiasm to use this by-product of sewage treatment has come mainly from the layman, but soil technologists and soil scientists continue to wonder why sludge is not returned to the soil for its plant food and fertility value. (Note that a distinction is made between plant food content and fertility value.) Many farmers, gardeners, florists and green-keepers have tried the material, but frequently have stopped after some years.

Sanitary engineers in general have looked at the sludge problem as a question of destruction of noxious matters rather than conservation of values. Sewage plant operators have tried to stimulate its use. There is an increasing tendency to find ways and means to utilize sludge, principally as a fertlizer filler or for soil improvement through direct application.

An inquiry to determine why the material is not used on a larger scale, especially from smaller plants, or why the use has been discontinued, seems to indicate several reasons which can be summarized as follows: (1) insufficient knowledge of the value, (2) improper use of the material or insufficient preparation, (3) excessive claims made by the seller, or (4) lack of interest by the seller.

*Journal Series Paper, N. J. Agricultural Experiment Station, New Brunswick, N. J., Dept. Water Sewage Research.
[1]Chief, Dept. Water & Sewage Research.

The Author

From a hygienic standpoint there is *no problem* if the sludge is used in a proper manner. A rather extensive inquiry made to determine whether ill-effects have been observed on animals or human beings, shows that where land disposal has been practiced for many years no disease or epidemics have occurred. This is probably due to the fact that users of large quantities of sludge have taken proper precautions. As a rule fresh sludge has been used only on forage crops and plowed under after application. Heat dried activated sludge and heat dried digested sludge appear to be safe for any reasonable use in agriculture, horticulture or floriculture, while well digested air dried sludge appears to be as safe as manures.

What Is the True Value of Sludge?

Determinations of the values in sewage sludges have chiefly been a matter of testing for the principal fertilizer ingredients (nitrogen, phosphorus and potash), while sometimes the organic matter content is taken into consideration. Users of sludge for agricultural or horticultural purposes have repeatedly called attention to the fact that the results obtained could not be entirely accounted for by the mineral or plant food constituents. The better results have been variously explained on the basis of: (1) the organic matter content of the sludge results in an increased moisture holding capacity of the soil, preventing retardation of growth or wilting during dry weather; (2) an improvement in the soil structure, especially in clay, allowing more air to enter and subsequently a stimulation of oxidation of organic matter by the soil organisms; (3) introduction of large numbers of bacteria and protozoa, resulting in a speeding up of decomposition, the introduction of micro-organisms, such as molds, into the soil, making the nutrients more available for the plants; (4) introduction of certain minerals needed for plant growth; absence of weed seeds, which may utilize the available plant food.

On the other side of the picture is the discontinuance of the use of sludge after several years on account of plant injury. The reasons advanced for plant injury have been mainly: introduction of poisons in the soil which were present in the sludge (certain industrial wastes); high grease content resulting in water logging and production of organic acids; burning of plants re-

When one observes the results attained with sewage sludge employed as a soil improver it becomes apparent that there are certain "hidden" values in sludges which are not revealed in an ordinary analysis such as chemists employ in determining the fertilizer value of sludges and other materials.

It has long been our opinion that sludges should have applied to them a different yard-stick of value than the ordinary fertilizer analysis alone. One day in broaching this subject to the author of this article he so thoroughly agreed, that we felt that he had something up his sleeve. This we learned on further conversation to be so, and Dr. Rudolfs was persuaded to prepare this article discussing the "fertility" value (i.e., the soil improving and growth promoting values) of sewage sludges, in distinction and in addition to their fertilizer values.

This matter of growth promoting substances in sludge has a definite sales appeal, which sewage works operators and managers can put to good advantage in this day of popularity of hormones and plant vitamins with florists, gardeners and horticulturists. However, as Dr. Rudolfs has emphasized, if the demand for the product is to be sustained; and, if the material is to be most effectively used and freed of objections to repeated applications, the matter of proper preparation of naturally lumpy and acid producing air-dried sludge is seemingly of prime consequence.

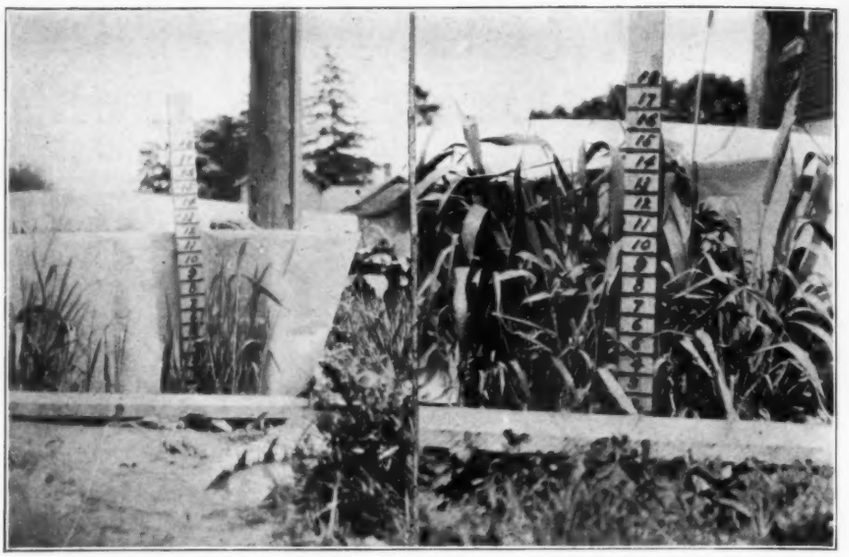
sulting from acidic decomposition products which make the soil acid.

Sludge Constituents— Major and Minor

Until a relatively short time ago it was assumed that only ten chemical elements (nitrogen, phosphorus, sulfur, calcium, magnesium, potassium, iron, carbon, hydrogen and oxygen) were indispensable for the growth of higher plants. Many other elements, if found effective, were regarded as plant stimulants. In 1914 Prof. Mazé at the Pasteur Institute in Paris, showed that other elements were necessary. Not much attention was paid until in 1923, when Miss Warrington at the Rothamsted Experiment Station in England found that boron was essential for beans and several other plants. Only during the last few years has it been found that a number of plants can not complete their growth cycle without minute quantities of boron, copper, zinc, manganese, possibly molybdenum and several others. These "minor," or "accessory," or "micro-nutrient" elements have a remarkable effect on various phases of plant growth. Iron, for instance, plays a role in oxidation, copper has been reported as essential in certain oxidase systems; manganese is essential to respiration and to nitrate reduction in plants; zinc may be important in the change of carbonic acid to water and CO_2; certain metal deficiencies produce chlorosis of varied types of green plants.

A Corn Crop

On this field 200 lbs./acre of pulverized air dried digested primary sludge was uniformly spread. The owner is now a real sludge booster; the reason being apparent.



A Small Grain Demonstation

In this instance, a 40-day growth of barley.

A compilation of the chemical composition of sludges, including the main fertilizer constituents and the "minor" elements, is given in Table I. For comparison it should be kept in mind that the average fertilizer ingredients of barnyard manures are about 2 per cent nitrogen, 1 per cent phosphorus (P_2O_5) and 1.5 per cent potash (K_2O). It is evident that in addition to the main fertilizer ingredients, small quantities of "minor" elements are present in the sludge which may play an important role in plant growth. The quantities of minor elements are relatively small, so that danger of poisoning the soil is absent. The quantities of lime salts present in the sludge varies with the hardness of the water supplies and the manner of sludge treatment. The amount of lime salts expressed as (CaO) may be as low as 2 per cent and as high as 12 per cent on a dry basis.

TABLE I

Average Chemical Constituents of Sewage Solids and Sludges.*

Element	Fresh Solids	Digested Sludge	Activated Sludge
Total Nitrogen (N)..	4.50*	2.25*	6.20*
Phosphoric (P_2O_5)....	2.25	1.50	2.50
Potash (K_2O)	0.50	0.50	0.75
Silica (SiO_2)	13.80	27.60	8.50
Iron (Fe_2O_3)	3.20	6.00	7.20
Aluminum (Al_2O_3)	2.10	4.30	3.20
Calcium (CaO)	2.70	5.70	1.70
Magnesium (MgO)....	0.60	1.00	1.40
Manganese (MnO) ...	0.02	0.04	0.03
Sodium (Na_2O)	0.80	1.50	1.00
Titanium (TiO_2)	0.06	0.10	0.08
Copper (CuO)	0.02	0.05	0.05
Barium (BaO)	0.05	0.10	0.06
Zinc (ZnO)	0.01	0.04	0.03
Lead (PbO)	0.10	0.20	0.20
Nickel (NiO)	....	....	0.005
Cobalt (CoO)	0.0002	....	0.0002
Sulfur (So_3)	1.2	2.5	2.90
Chlorides (Cl)	0.50	0.50	0.50
Chromium (Cr_2O_3) ...	....	....	0.20
Arsenic (As_2O_3)	trace	trace	0.013
Boron (Br_2O_3)	....	....	0.0115
Iodine (I)	....	....	0.001

*All figures being % of each ingredient on the dry basis.

Humus Value

As a soil builder the humus content of sludge is less than that of barn-yard manure, because the ash content is greater, but still is of considerable value in sandy and heavy clay soils.

The crude fiber (cellulose, lignin, etc.), being complex insoluble carbohydrates, resist bacterial decomposition and remain longer in the soil (table II). Most of the so-called total organic matter gradually disappears, but is of importance from the standpoint of humus accumulation and moisture holding capacity of the soil. Soils which retain a higher moisture content, usually support a greater variety of plants and allow the plants to continue their growth even during dry spells.

Fats and greases are important chiefly because they make the sludge lumpy and interfere with the desirable uniform distribution of the sludge. Also, because grease decomposition produces acidic compounds, resulting in acidic soils. It is our experience that most of the injurious

TABLE II

Composition of Sludges.

Constituent*	Fresh Solids	Digested Sludge	Activated Sludge
Organic Matter ..	60-80*	45-60*	65-75*
Total Ash	20-40	40-55	25-38
Insoluble Ash	17-35	35-50	22-30
Pentosans	1.0	1.50	2.10
Grease & Fat (Ether)	7-35	3.5-17.0	5.0-12.0
Hemicelluloses	3.2	1.6	.....
Cellulose	3.8	0.6	7.0‡
Lignin	5.8	8.4	.....
Protein	22-28	16-21	37.5

*All figures being % of each constituent on the dry basis.
‡Includes lignin, etc.

effects that may be chargeable to sludge application for a number of years are due to the accumulation of acids in the soil. The first few years these acids have a tendency to make insoluble plant foods present in the soil more available; hence, produce better results than might be expected from the sludge alone. After a few years the available insoluble plant food has been reduced and the soil becomes more and more acid. Certain plants, which desire a neutral or only slightly acidic soil, are retarded in their growth and finally are injured by the accumulated acidity. The simple application of agricultural lime (carbonate of lime) neutralizes this acidity. For best results in the long run, a judicious lime application every 3 or 4 years prevents a good deal of trouble. The fact that this simple remedy often has been overlooked accounts for reluctance of farmers and geenhouse growers to use sludge after a few years' trial.

Growth-Promoting Substances

Increasingly, it is recognized that plants do not synthesize vitamins or their precursors as a philantropic act for the benefit of animal or man. These substances have a function in the plant itself. The substances are generally classified as growth-promoting substances, since they may induce root development, stem elongation, cell swelling, ripening of fruit, stimulate germination and flowering, and produce other responses. Farm yard manure and decaying vegetable matter have been shown to contain various growth-promoting substances. Tests made for the presence of some of these substances in sewage sludges are summarized in Table III.

The quantities of growth-promoting substances required to affect the growth of plants are extremely small. Comparatively large applications of artificially produced compounds may even cause injury or retardation. Indole and skatole derivatives appear to be among the most effective growth-promoting substances. Indole and skatole, as well as butyric, acetic and propionic acids, are produced during decomposition of sludge and can be expected to be present. The presence of various growth-promoting substances give to sludges a higher *fertility value* than indicated by a mere chemical analysis, which reveals only the principal *fertilizer ingredients.*

TABLE III

Presence of Growth Promoting Substances in Sludges.

(Relative Amounts of Single Substances.)

Substance	Fresh Solids	Di-digested Sludge	Activated Sludge
Skatole, p.p.m.	1.2 -7.8	traces	none to traces
Indole, p.p.m.	0.12-7.0	0.5-1.0	0.0-0.05
Ascortic acid (Vitamin C)	++++	++++	++++
Carotene	+++	++	+
Tryptophane (free)	++++	+	++
Tryptophane (combined)	++++	++	+++
Tyrosine (free)	++++	+	++
Tyrosine (combined)	++++	++	+++
Phenyl compds.*	++++	++	++
Naphthyl compds.‡	—	—	—

*As benzoic acid; ‡ as ∝-naphthol.

Practicing farmers have maintained for years that mineral fertilizers "burn out" the soil. What is meant is that mineral fertilizers stimulate the destruction of organic matter, making the plant food, plant stimulants and hormones available in greater abundance. This results in increased crop yields, but also gradually reduces the stored-up fertility of the soil. Thereby, the soil becomes poorer. The value of farmyard manure is in replenishing the organic matter, "minor" elements and growth-promoting substances. Its application is of importance, therefore, in making the soil gradually richer. A similar function can be ascribed to sewage sludge. Since sewage sludge contains only relatively small amounts of the principal fertilizer ingredients crop yield cannot be as great as from mineral fertilizers; but, like other improved animal manures, it improves the soil and will continue to do so if acidity is checked by lime applications.

Sludge Enrichment or Sludge Filler

The addition of mineral fertilizers to enrich sludge results in a more complete product. Not only are the necessary major plant foods present, but the required "minor" elements and growth-promoting substances are available. This combination produces a balanced fertilizer and, also, a soil builder. This balanced product gives higher crop yields without loss of soil fertility. Such a balanced product is of especial value for sandy and clay soils. The response of rich loamy or peaty soils to this balanced product should be less and it explains partly why experiments

Preparation and Conditioning an Important Consideration in Marketing

Compare the handleability and saleableness of the lumpy product on the left as removed from the drying beds, and the uniformly granulated and aerated product turned out by a well known sludge disintegrator.

conducted with various crops in different soils may appear to be contradictory.

The amount of organic matter present is of importance, because of its favorable effect on the absorption capacity of the soil, and is of further interest because it is the carrier for organic nitrogen, which aids bacterial decomposition and becomes available to the plant when needed.

Crops and Plants Benefitted

A compilation of plot experiment results and actual practice of crops and plants which have been benefitted from sludge applications (Table IV) indicate that a number of grasses, root and leaf crops, trees and shrubs respond to sludge. The list is incomplete, because only those plants have been included where sludge was of *definite* value. Cases where the value was doubtful or contradictory heve been disregarded. Sludge has been found to be of particular value on lawns and greens. It does not cause "burning," but small applications of lime are necessary from time to time.

A Potato Crop—With and Without

From the same area, in a field side by side, potatoes on left were fertilized with 400 lbs./acre of Toledo's air-dried digested primary sludge, marketed under the name "Tol-e-Gro." The yield was just 200 per cent more than the pile on right not fertilized.

TABLE IV

Crops and Plants Which Have Benefitted from Sludge Applications.

Field crops and fruits	Truck crops
corn	squash
wheat	tomatoes
rye	turnips
barley	pumpkins
turnips	beets
grass	carrots
beets	radishes
mustard	parsnips
potatoes	onions
tobacco	string beans
cotton	lima beans
apples	lettuce
citrus fruits	spinach
strawberries	sweet corn
	cabbage
	(and others)
Flowers	**Trees and shrubs**
roses	maple
carnations	ash
[Many annual flowers respond to sludge, in some cases leaf growth is more stimulated than is flowering.]	birch
	chestnut
	prunus
	cornus
	jasminium
	hydrangea
	berberis
	spirea
	daphne
	cotoneaster
	taxus
	several broad leaf evergreens

The amount of sludge applied varies with the crop. For field crops the application varies from 6 to 10 tons per acre, but additions up to 40 tons per acre have produced good results. A number of nursery men have reported good results with young trees and shrubs with sludge used in a manner and in quantities such as would be used if the material were barn-yard manure.

Over-All Value

The *fertility* values together with the *fertilizer* value of sewage sludges may be summarized in general as follows:

In addition to relatively small amounts of the principal fertilizer ingredients, sewage sludge contains "minor" chemical elements and growth-promoting substances essential and necessary for proper plant growth. It prevents depletion of humus and is capable of increasing the fertility of the soil. It improves the soil structure in general and increases the water holding capacity of sandy soil in particular. The value of sludge is not the same for all soils, neither is it the same for all crops. Except for growth observations there is no adequate measuring-stick for revealing the over-all value of sewage sludges as soil improvers and growth promoters—in short, their fertility values as contrasted to their limited worth as fertilizers, based on the chemist's analysis alone.

SOMETIMES LITTLE THINGS MAY COUNT

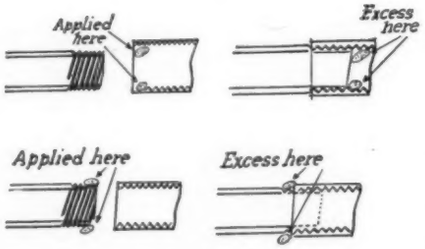
A "Dear Bill" Letter From Henry E. Nunn, Supt. of Water Works, Van Buren, Arkansas.

Dear "Bill,"

Sometimes we don't know about things and sometimes we do know but just get careless. In either case it all adds up to the same thing in so far as the people who are depending on us for good safe drinking water are concerned.

Here is an example of what I mean:

Sometime ago, I saw a pipe laying crew that may be classed either way for they were creating a hazard needlessly. They were laying 2 inch galvanized pipe and using white lead to obtain good tight points. The lead was being applied to the threads inside the coupling instead of being placed on the threads on the outside of the pipe. When the joint was made up the excess lead was forced ahead along the threads and into the pipe to be picked up by the water and delivered to the consumer to drink. If the lead or other compound is put on the threads of the pipe and not the coupling, when the joint is made up the excess will be forced back along the threads to the outside of the pipe where it will be harmless. My little sketch explains it better than words.



That is a small thing and takes no more time to do it one way than the other, but it may mean the difference of avoiding some justified complaints that can be serious.

Yours for more water and less lead,

HEN.

Mr. Nunn, in using this style of giving fellow operators a useful kink, states: "I hope Doc Taylor won't think I'm stealing his stuff." Matter of fact, "Doc" started this "Dear Bill" letter idea hoping that others would also come through with their "stuff."—L. H. E.

LIQUIDS DO NOT FLOW "EN MASSE"

By R. D. NICHOLS*
COLUMBUS, OHIO

ANY study of the coagulation-flocculation phenomena must give consideration to the principles of chemistry, mechanics and hydraulics. The kind and amount of coagulating chemicals and the type and degree of stirring for the most efficient and economical results, can be determined by batch test conducted in the laboratory. The hydraulics of the flowing stream, however, can only be determined by test under conditions of continuous flow.

The hydraulic characteristics of continuous flow basins equipped with mechanical mixers can be obtained by testing continuous flow models. Several years of work have developed data of an interesting and important nature.

The work with which this article is concerned started in 1937. It included a study of the literature and the testing of small models. In the early stages chemical flocculation tests were conducted, mainly to determine the type and degree of mechanical stirring that would be comparable to batch tests. It was soon found that short-circuiting of liquid under treatment could be the direct cause of failure to attain the desired results, especially so if the time periods indicated by batch work were used in continuous flow treatment.

Langelier (1) as far back as the year 1921 pointed to this and suggested an improved design of basin and mixer. One of the three small models tested in 1937 followed Langelier's suggestions. It proved more efficient than the others because of the absence of detrimental short-circuiting. "Tapered" mixing also proved to be an advantage. By "Tapered" mixing is meant the gradual de-celleration of velocities in the mixing and floccing chambers.

Plant design studies showed the use of separate cylindrical tanks to be somewhat higher in initial cost than certain other types. The least expensive design was selected and the work continued.

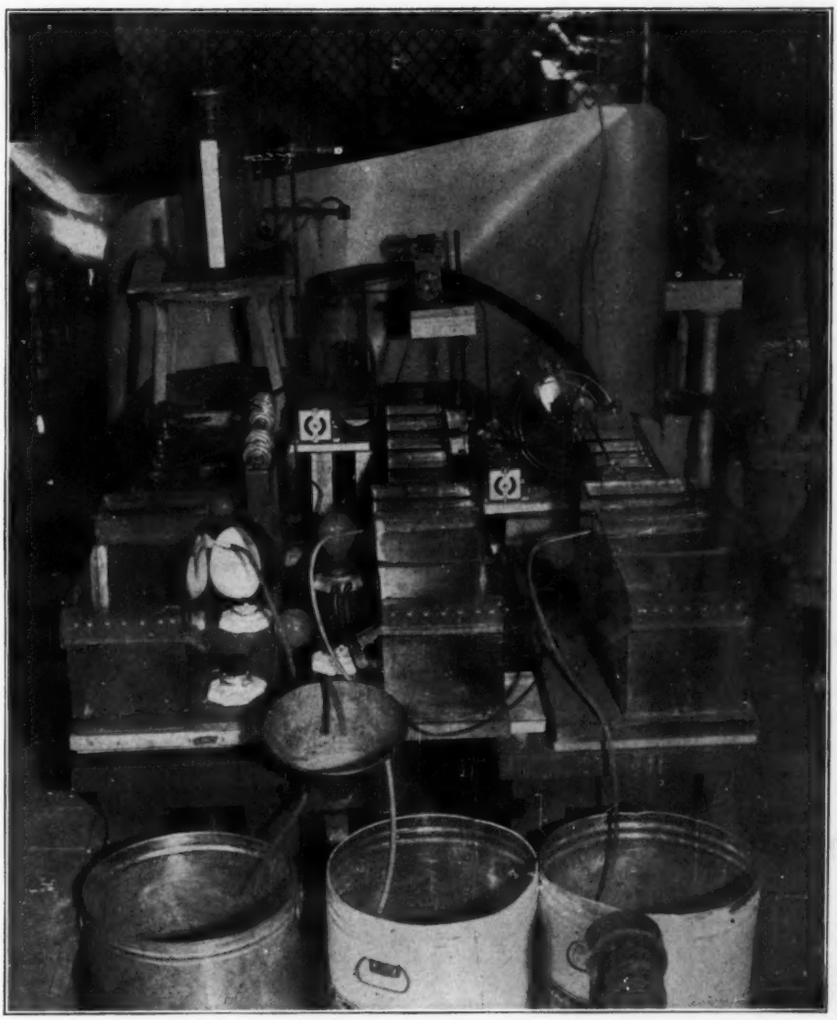
Calvert (2) in 1939 reported in this magazine on the progress of the experimental work. His paper also revealed an interesting comparison of plant opearting data compiled after about one year of

The Author

operation of the plant scale flocculating units designed from experimental data and information disclosed during the model studies begun in 1937.

The writer has extended the earlier experimental work with the idea of developing features that would further improve the hydraulic characteristics of mechanical flocculation basins.

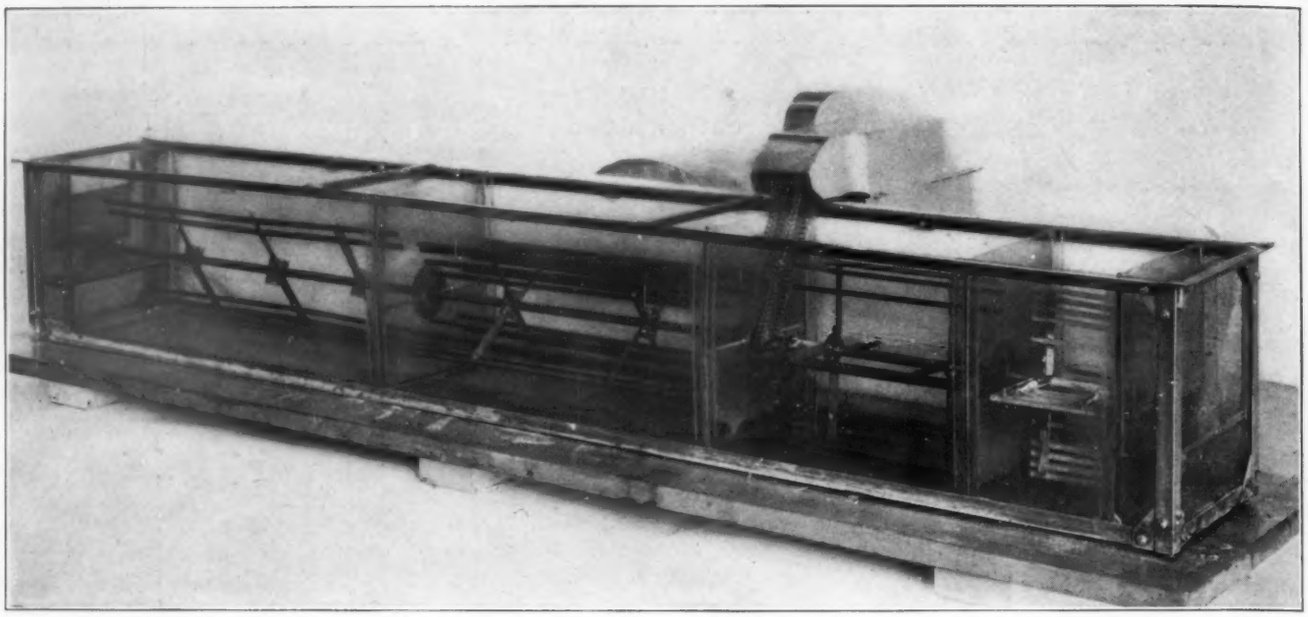
Dilution of the liquid under treatment in a chamber with the incoming liquid is one cause of short-circuiting. Mechanical mixing, of course, causes dilution to take place rapidly. Therefore, unless control is provided the portion reaching the discharge end of the mixing or flocculating chambers before the elapse of the theoretical time period will be excessive. A basin 60 feet long was selected as average and most of the model testing has been of a prototype of this length. For a retention period of 30 minutes the average horizontal velocity would, thereby be only 2 feet per minute. Such a relatively low cross sectional



The Original Models

Comprising a study of tank dimensions, velocities, paddle design and speeds, floc quality and chemical requirements.

*Development Engineer, The Jeffrey Manufacturing Co.



One of the Newer and Larger Models

Employed in the more recent experimental work, looking to improving the hydraulic characteristics of mechanical flocculating basins. With it the hydraulic data discussed in this paper was developed. The paddle wheel construction, chamber dimensions, partition ports and port-baffles represent in miniature design now in use.

velocity is conducive to short-circuiting, even though stirring was not practiced.

Model Studies

All models for the studies have been made in exact scale ratio to selected prototypes. In some, the paddle wheels were mounted upon a single continuous shaft; and in others the shaft was split at the end of the second compartment so that the fore portion could be operated at higher r.p.m. Paddle wheel speeds were made variable through changes of sprockets in the chain drive. Variation in rates of stirring were also made by changes in the number and arrangement of paddle blades. One of the accompanying photographs reveals the type of construction employed in the model studies.

Operation of Models

Since 1939 all studies have been directed toward developing the hydraulic characteristics of modified designs of this general type of mechanism and longitudinal style of flocculating chambers. Briefly, the changes studied were the arrangement of partitions, paddle wheel stirring mechanisms, rates of stirring, and position and sizes of communication ports between the compartments of the chamber. No flocculation tests were conducted. Hydraulic conditions in the prototype can be portrayed, by model testing, if dynamic as well as static similitude laws are followed. Building the models to an exact scale, of course, assures adherence to static laws. Obtaining dynamic similitude requires adjustment of the rate of flow and speed of rotation of the paddle wheels on the basis of the square root of the scale ratio of model to prototype.

Test Procedure

Briefly, each test comprised feeding a known quantity of salt in solution into the influent and determining the concentration of salt in the effluent at frequent intervals. Such was done by taking readings of relative resistivity, using a Leeds and Northrop galvanometer and a platinum electrode. The salt solution used was 50 grams of air dried NaCl (c.p.) dissolved in one liter of distilled water. For each test there was fed 100 ml. of this solution which, of course, was 5 grams of NaCl.

Tap water was used in each test, the effluent going to drain. The rate of flow was checked carefully before and after each passage of salt solution, by timing the period for passage of one liter. Care must be taken to obtain an average depth of liquid in each compartment consistent with the theoretical, such proving is especially important when partitions having restricted ports are used between compartments.

With the galvanometer and cell only a difference in relative resistivity can be obtained, therefore it is necessary to develop a curve with difference in reading as ordinates and known concentrations of NaCl as abscissa, the resistivity reading of the tap water being of course zero. Since temperature as well as other variables affect resistivity readings, this curve should be developed for each test. The procedure followed in this work was to dilute various quantities of the prepared salt solution with the effluent from the model after the water temperature reached stability.

With the model set up and all adjustments made, 100 ml. of salt solution was fed into the influent and the time noted. Periodic readings at uniform time intervals (in all model tests, such being 10 seconds) were made and difference in reading as well as time noted. From the curve above-mentioned was obtained p.p.m. of salt concentration. This was then interpolated into milligrams of salt recovered by multiplying p.p.m. by the quantity of flow in liters passing in the time interval between readings. The "Dispersion Index" (3) is a good indication of hydraulic conditions. Consideration should also be given to the shape of the curve. The first salt bearing solution should not appear at the effluent end too early and the peak concentration should occur near the end of the theoretical retention time. The cumulative curve is, of course, necessary for calculating recovery and the "Dispersion Index."

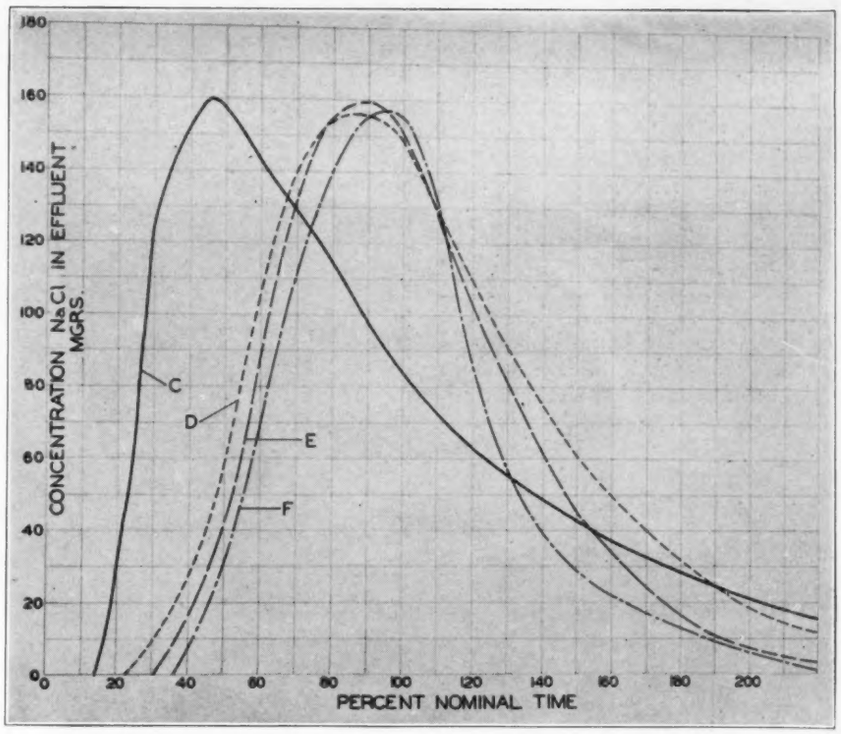
Results

For comparsion of results, we may first select a curve developed for a prototype 12 feet square in cross-section and 60 feet long; which, for a 30 minute retention

period would pass approximately 4 m.g.d. This basin was provided with a paddle wheel extending from influent to effluent end but no partitions were used. The "Dispersion Index" obtained by test was 5.0 as shown by Curve C in the accompanying specimen graph. The first of the salt bearing liquid reached the effluent end in approximately 14 per cent of the theoretical retention time —i.e., in 4.2 minutes. Ten per cent of the salt bearing liquid passed in 36.6 per cent of the nominal time (approximately 11 minutes), thus indicating poor hydraulic conditions.

The next test was made after dividing this tank into compartments, by placement of spaced partitions having ports of communication at the axis of the paddle wheel shaft. The ports were made small enough to create a slight loss of head. This change effected the improved results indicated by Curve D. It will be observed that the "Dispersion Index" was 2.77 and that the first of the salt did not show in the effluent until 22.2 per cent of the theoretical time had elapsed. The increase in concentration in the effluent was less rapid, the peak or mode of the curve being reached only after 78.3 per cent of the theoretical passage time, as compared with 45 per cent observed in Curve C. The time for 10 per cent to pass the effluent was increased to 60 per cent of nominal or 18 minutes. It became evident that care should be exercised in selecting the size of ports. If the openings should be too small high port velocities will result in channeling of flow in the suceeding compartment, rather than in the desired "mushrooming" of the stream entering each succeeding compartment wherein paddle velocities are becoming successively slower.

Still further improvement can be had by installing baffles immediately beyond the ports to dissipate port velocity and insure "mushrooming" by directing the flow outwardly into the path of the paddle wheel blades. The use of such baffles permits a decrease in the size of port, resulting in a greater loss of head across the partition and consequently greater control over short-circuiting. Port velocities should not exceed 1.5 feet per second, otherwise floc will be broken or shredded. It has been found that a port velocity of 1 foot per second for maximum flow is sufficient for creation of good hydraulic conditions, even though the flow may vary considerably.

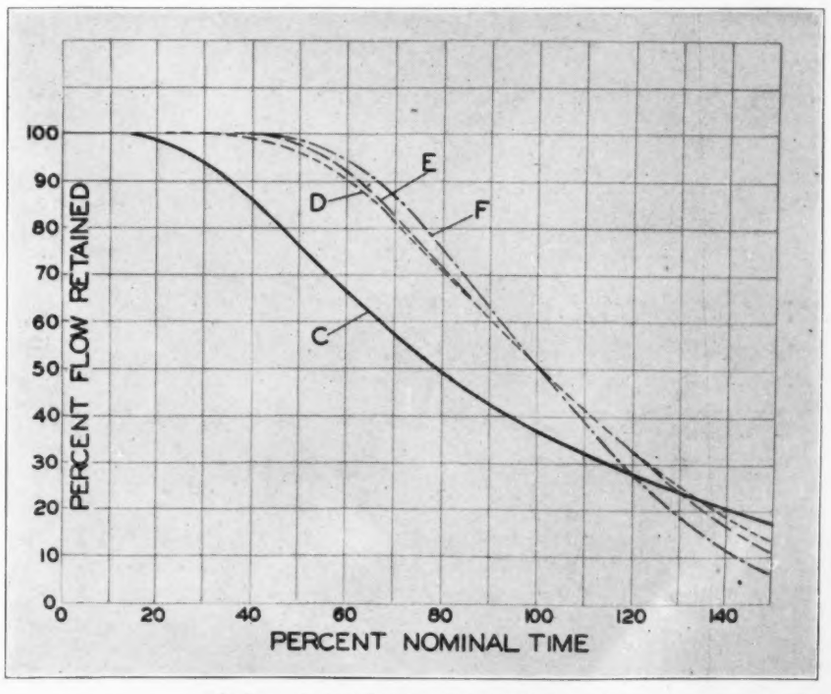


Salt Displacement Tests

Curves C, D and E reveal salt tests plotted for models. Curve F is a test applied to a full-sized installation.

Curve E was developed using a partitioned model, the ports of which developed port velocities of 1 foot per second. Port baffles of a diameter approximately one and one-half times that of the port were mounted on the paddle wheel shaft. In this test the "Dispersion Index" was further reduced to 2.5. The first of the salt bearing liquid did not appear in the effluent until 31.7 per cent of the nominal time and the mode or peak of the curve moved to 91 per cent of nominal, indicating a further improvement in hydraulic conditions. With this arrangement variations in flow can be handled without affecting the hydraulic characteristics seriously.

Still further improvement can be



Displacement and Short Circuiting Ratio

Curves revealing the effect of design on the length of time any portion of the flow was retained in the floccing unit.

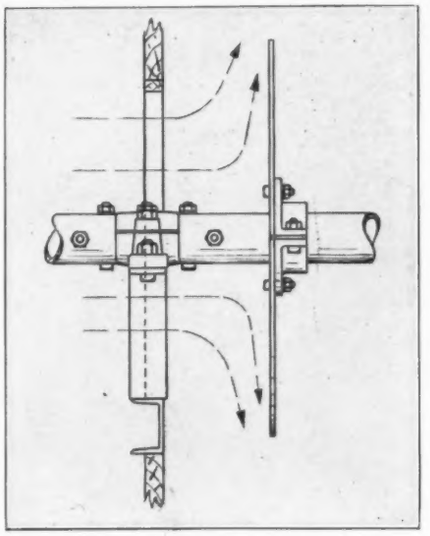
had by eliminating spaces where eddy currents may develop. Curve F is for a test of an actual installation in a water treatment plant, in which the basin is 9 feet square in cross-section and 57 feet long. The fundamental difference in this tank was the filling in of the corners where the bottom and the side walls meet, the paddle wheel, partitions and port baffles were the same as for test Curve E. This means a slightly lessened volumetric capacity as compared with a tank square in cross-section, but when it is considered that with good hydraulic conditions shorter retention periods can be utilized, such modification is justified.

In this test (Curve F) the first of the salt bearing liquid did not appear in the effluent until 36 per cent of nominal time and for 10 per cent to pass required 65 per cent of nominal. The "Dispersion Index" was 2.11, with the peak of concentration at approximately 100 per cent of nominal.

A comparison of the hydraulic characteristics based on a curve in which per cent of flow retained in the zone of action is plotted as ordinates and per cent of nominal time is plotted as abscissa is of interest. (See graph.)

In test Curve C, 90 per cent of the flow was retained only 35 per cent of the nominal time; in test Curve F, 90 per cent was retained 65 per cent of the nominal time, an increase of 85.7 per cent. In test Curve C, 80 per cent of the flow was retained only 47 per cent of the nominal time, while in test Curve F, 80 per cent was retained 77 per cent of the nominal time, an increase of 63.8 per cent.

In Curve C it will be noted that the time for 50 per cent of the flow to pass was less than 100 hundred per cent of nominal, indicating that a portion of the tank was ineffective, or in other words, the liquid in some portion was not displaced within the theoretical time limit.



Sectional Sketch

Through a partition, showing the port and rotating baffle on shaft beyond. Such baffles have materially improved the "Dispersion Index"—see text.

Discussion

The data given is for basins of a length which may be considered average. Increase in length of basin will, of course, increase the nominal horizontal velocity through the tank. The term "nominal horizontal velocity" signifies the velocity of flow if all portions of the mass moved at the same velocity (such as a piston head) and no dilution or short-circuiting took place. In longer basins, a greater number of subdivisions can be made and less short-circuiting of liquid will occur and of course lower dispersion indices will be obtained.

Increase in retention period alone will not correct the bad effect caused by short-circuiting. If pronounced short-circuiting is permitted a relatively large portion of the liquid may reach the effluent before the lapse of the minimum time to complete flocculation, even though the retention period may be considerably longer than 30 minutes.

Some of the flow will, of course, be retained for a longer time than the theoretical. However, the advantage of overtreatment, if any, will not offset the disadvantage caused by short-circuiting.

This article makes no attempt to delve into the phenomenon of flocculation, the main purpose being to point out how to gain good hydraulic conditions and how models may be used to portray results. The minimum time required to produce coagulation and flocculation in complete form can be obtained from batch tests. If short-circuiting in the basins is eliminated laboratory batch tests can be used for comparison and control. The results of a correct procedure in batch test can be duplicated in the plant without modification as to chemical dosage and rates of stirring.

Conclusions

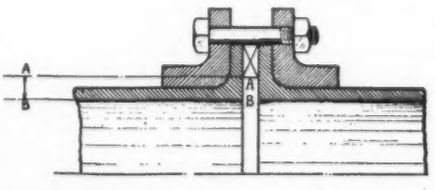
1. Short-circuiting in basins fitted with stirring devices can be practically eliminated.
2. In this attainment compartmental divisions of basins is mandatory, unless the tanks be of great length.
3. Ports of communication between chambers should be at the axis of the paddle or at the "dead center" of action.
4. The ports should be such that a loss of head across division walls is created.
5. Baffles should be placed immediately beyond the ports so as to divert the flow to the zone of action of the paddle wheel.
6. All spaces near the periphery of the paddle wheels, where eddy currents may occur, should be eliminated.

REFERENCES:
(1) Langelier, W. F., Eng. News Record, June 2, 1921.
(2) Calvert, C. K., W. W. & S., June, 1939.
(3) Morrill, A. B., Jour. A. W. W. A., Vol. 24.

ON MAKING GASKETED JOINTS WHEREIN "OLD PRACTICE" BECOMES "NEW PRACTICE"

Ten years ago gasket users were told by pipe specialists that the gasket arrangement shown in this sketch was *wrong*. We were told that the space AB should be entirely filled in order to make the inner surface flush and thereby eliminate eddy currents. In other words, the inner edge of the gasket, they told us, should be a continuation of the inner pipe surface.

Today it is agreed by prominent engineers that while there is an acknowledged *slight* advantage in eliminating eddy currents, the important problem is to place the gasket in the position that gives it maximum benefit from bolt pull, with minimum flange and fitting stress. These items are of far greater importance than any possible friction loss created by the eddy creating arrangement shown in the accompanying sketch.



Therefore, although manufacturers of square lapped van stone joints go to considerable trouble and expense making square laps, as shown in this sketch, it is now obvious that in many instances rounded corners, as made years ago, would be just as good or better. It is easier and less costly to make the corners rounded than it is to make them square.

Thus here we have the rare example of "old practice" (once discarded) turning around to become "new practice".

*Contributed by W. F. Schaphorst, M.E., Newark, N. J.

Christmas Reflections

If nobody smiled and nobody cheered
And nobody helped us along,
If each minute looked after itself
And the good things all went to the strong,
If nobody cared just a little for you
And nobody thought about me,
And we stood all alone in the battle of life
What a dreary old world it would be.

Life is sweet because of the friends we have made
And the things which in common we share.
We want to live on not because of ourselves
But because of the people who care,
It's giving and doing for somebody else
On that all life's splendour depends,
And the joy of the world when it's all added up
Is found in the making of friends.

ANON.

INDUSTRIAL CHEMICAL SALES
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DIFFUSER TUBES FOR AERATION

Come into their own

Aeration tanks at new Gary, Indiana, Activated Sludge Plant.
Alvord, Burdick & Howson, Consulting Engineers, Chicago, Illinois.

THE benefits of diffuser tubes have been well known for many years. They have been proved in more than 50 "ALOXITE" Brand installations in relatively small plants from coast to coast.

- *Simple Assembly*
- *Low Cost*
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Recently the Chicago Pump Co. developed a new design which made these benefits available for large plants. The Gary installation illustrated is the largest (40 MGD—2250 tubes). Several others are built or under design. Added money saving features of this new design are:

- *A wide band of air diffusion resulting in more efficient oxygenation*
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Specify "ALOXITE" Brand Diffuser Tubes for your aeration to secure a product proved by years of service. They are now available in three sizes to meet all requirements.

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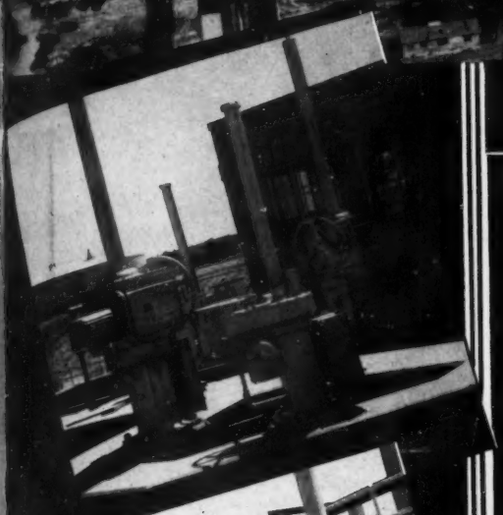
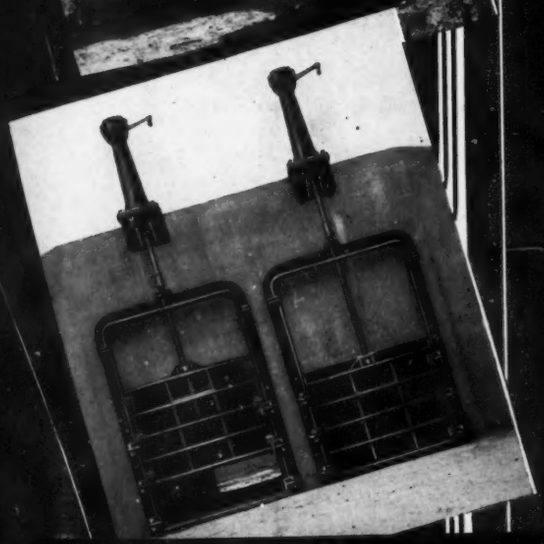
for THE WORLDS LARGEST

OR THE SMALLEST !





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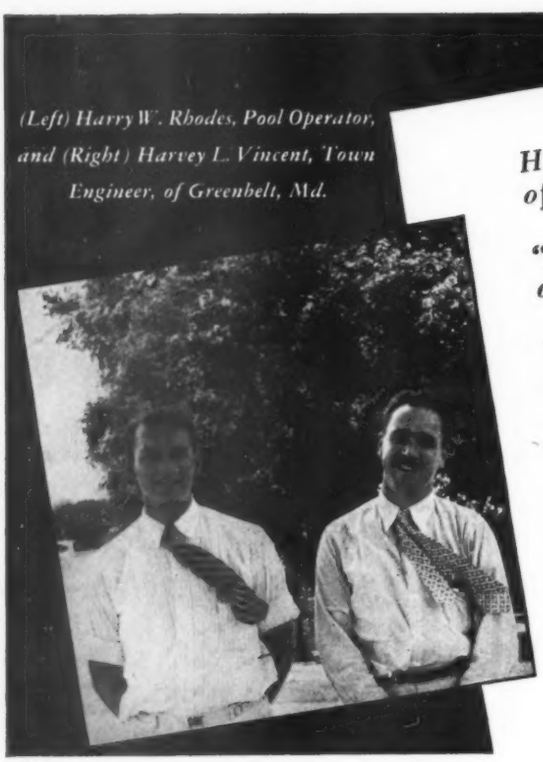

(Left) Harry W. Rhodes, Pool Operator, and (Right) Harvey L. Vincent, Town Engineer, of Greenbelt, Md.

Harvey L. Vincent, Town Engineer of the Town of Greenbelt, Maryland, says:

"We have been using HTH in several ways since our operations started in 1938.

"We keep a good supply of this product on hand and consider it a stand-by source of chlorine in case we encounter any trouble with the chlorination equipment at either the swimming pool or the sewage treatment plant.

"We also use your liquid chlorine for sewage treatment plant operations, and are glad to take this opportunity to express our appreciation of the good service which your organization has given us. Dependable sources of supply are an important asset in the successful management of community and municipal services."

● Greenbelt, Md. typifies the modern suburb. And its Town Engineer, Mr. H. L. Vincent, expresses the modern point of view in his appreciation of Mathieson sanitation service. Trouble-free containers and valves, and prompt delivery service, keep Mathieson Chlorine in tune with modern ideas of efficiency. HTH offers a dry, free-flowing chlorine carrier delivering over 70% available chlorine—quick, handy sterilizer for many special and emergency jobs.

Greenbelt's community swimming pool and surroundings are also kept sanitary the modern, efficient way—with Mathieson Chlorine and HTH.

But most of all, you will appreciate —as do hundreds of other sanitary engineers—the dependability of Mathieson as a source of supply, a dependability established for nearly fifty years.

HTH comes in 5 lb. cans with replaceable caps, packed 9 cans to the case; also in 100-lb. drums.

THE Mathieson Alkali Works (INC)

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LIQUID CHLORINE . . . HTH . . . SODA ASH . . . CAUSTIC SODA . . . BLEACHING POWDER . . . BICARBONATE OF SODA . . . AMMONIA, ANHYDROUS and AQUA . . . PH-PLUS (FUSED ALKALI) . . . DRY ICE . . . CARBONIC GAS

SLUDGE DISPOSAL WITH A BIT OF GLAMOUR

By WELLINGTON DONALDSON
Director, Bureau of Sewage Disposal,
Department of Public Works
NEW YORK CITY

IT IS fortunate that the routine of municipal business is relieved occasionally by pleasant incidents.

Such was the case on November 4th when Commissioner Irving V. A. Huie and a group from his official family saw fit to recognize the 1000th voyage of the sludge carrier—M. V. "Wards Island." The occasion seemed to warrant an official inspection trip to the deep-sea dumping grounds on this the first in service of the department's three vessel sludge fleet, when she came to the century mark in number of voyages to her credit.

Leaving the dock at Wards Island at 8:50 A. M. with a load of sludge and her buntings flying, the "Wards Island" headed for sea; passed under the six bridges spanning the East River; passed in review the spectacular skyline of Manhattan, thence along the Brooklyn shore, by Governor's Island through the Narrows, and out through Ambrose Channel to sea.

Reaching the dumping grounds (34 miles out) at 12:55 P. M., and pulling the dump valves, her cargo of sludge was dumped in just seven minutes by the simple maneuver of a "U" turn. Returning, the vessel was made fast to the Wards Island dock at 4:45 P. M. after making a stop at the 69th Street pier in Brooklyn to discharge some of the official party. The round trip of 68 miles was thus longer than the normal 6½ hours.

The Author
"Admiral of the Wards Island Navee"

In such simple manner was final disposal given to 55,000 cu. ft. of sewage sludge from the Wards Island Plant, without any nuisance or more ado then throwing the valve levers.

A 50,000,000 Ton Duty Performed

The M. V. "Wards Island" in completing this 1000th voyage had traveled a distance of approximately 70,000 nautical miles since the vessel was commissioned on Jan. 17, 1938, and had alone removed in that period about 50,000,000 cu. ft. of sludge, 98 per cent of which came from the Wards Island Plant and 2 per cent from the Tallmans Island and Bowery Bay Plants.

Since the disposal of sewage sludge by dumping into sea is a practice limited, at present, to only a few American communities, namely, New York, Passaic Valley, Elizabeth, N. J., and Providence, R. I., it may be interesting here to picture the relationship of this particular voyage to the entire situation of sludge disposal in New York City.

One may assume that the contribution of sewage solids from the entire New York City population amounts to some 800 tons daily on a dry basis, that is disregarding the large water content of the material. Perhaps 85 per cent of these solids might eventually be captured by treatment of the whole of the sewage. The existing treatment plants, which now handle only about 33 per cent of the total sewage, now account for some 220 dry tons of solids per day. Of this total, the Coney Island Plant accounts for about eight dry tons daily, which sludge is digested and air dried on sandy areas and utilized as fertilizer material by the Park Department of the city. Except for minor quantities represented by fine screenings, which are composted and used for fertilizer by the Park Department, the remaining sludge solids are barged to sea. This material comprises the primary and excess activated sludge from Wards Island, the primary sludge from Bowery Bay and the digested combined sludge from the Tallmans Island Plant.

The Sludge Vessels Are Real Ships

The sludge vessels owned and operated by the Department of Public Works are not in any sense sludge "scows." They are trim sea-going vessels, twin screw, diesel powered,

The 1000th Voyage of the "Wards Island" An Occasion

(Left)—Loaded with 55,000 cu. ft. of Sludge and with Buntings Flying Ready to Go. (Center)—Down the East River, Under Famed Brooklyn Bridge, and to Sea, a Real Ship Trim and Worthy. (Right)—"Homeward Bound"; a 50,000,000 Ton Duty Performed with This 1000th Trip Completing 70,000 Nautical Miles

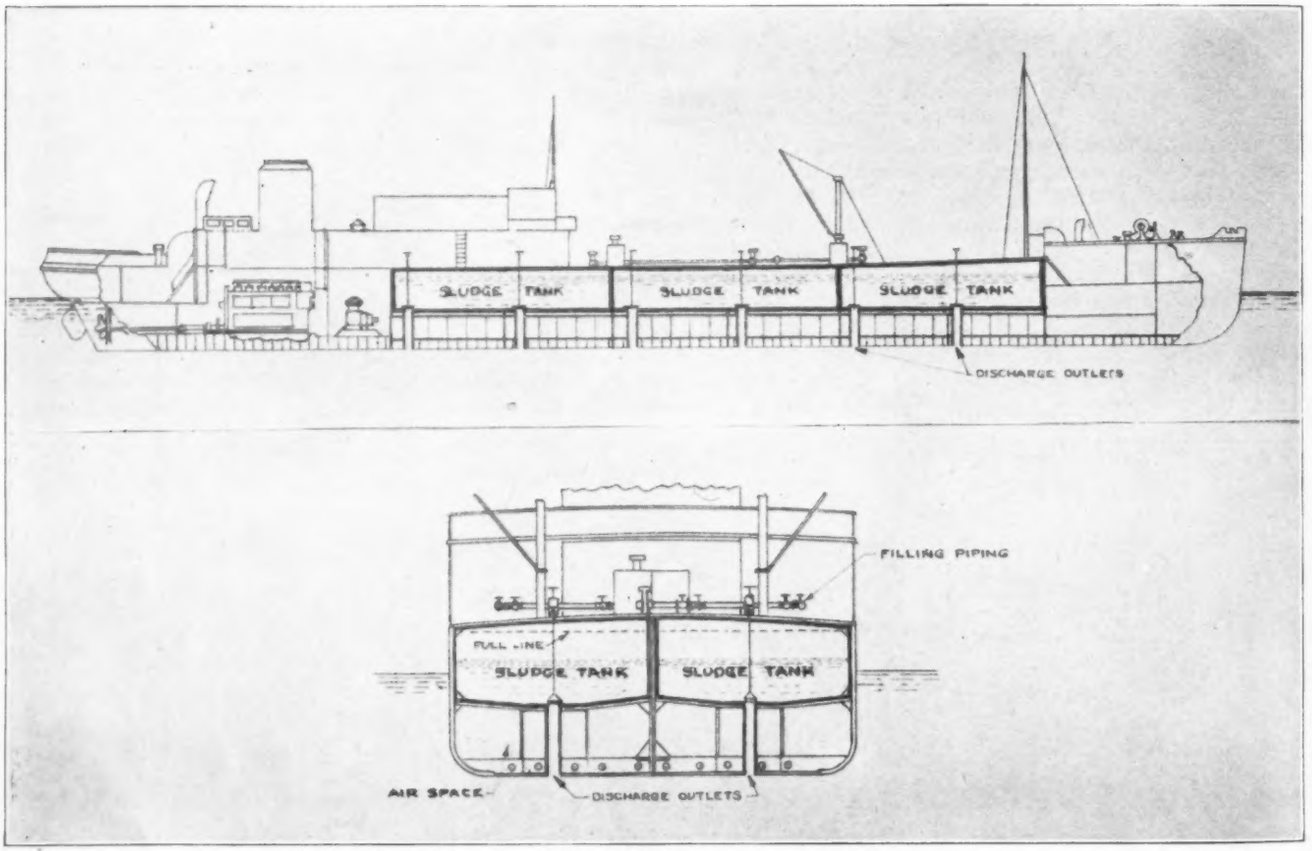
"En Voyage"

(1)—No. 1 Passenger, Irving V. A. Huie, Commissioner of Public Works, N. Y. City. (2)—We have reached the dumping grounds 34 miles out, and the valves have been pulled; what of our cargo does not go to the fish, the seagulls clean up; we suspect though that these birds are more interested in the feeding fish than in what may float their way. (3)—Here is the "Skipper," Captain P. H. Hoffman, who can turn his ship "on a dime" in Hell Gate; and that is something.

and have a cruising range of about 2,500 miles without refueling. The three vessels christened "Wards Island," "Tallmans Island" and "Coney Island" are identical in construction and are fully equipped with safety appliances, including radio communication facilities. As a protection against the nature of the "cargo," each vessel has installed ventilating stacks containing a battery of activated carbon cannisters for absorbing objectionable odors and gases which may be evolved during summer conditions.

The three sister ships, with rakish lines (see stern view), have the following dimensions and other characteristics:

Length overall	257′-3″
Breadth molded	43′-6″
Depth molded	16′-0″
Full load (mean draft)	11′-0″
Displacement (sea water)	2,610 L.tons
Freeboard (full load)	5′-0″
Engine (twin diesel)	1,300 b.h.p.
Speed loaded	10½ Knots
Cargo (deadweight capacity	1,430 L.tons
Volume capacity (6 sludge tanks)	55,000 cu. ft.



Longitudinal and Cross Sections of Sludge Vessels

Note the elevation of the sludge tanks in respect to water level. As the tanks empty the ship rides up; at the empty line of displacement the dump valves are above the water line; the average full load of 55,000 cu. ft. can be dumped in 4 to 4½ minutes. At full loading the free-board is only 5 feet. Further details appear in an accompany tabulation.

The three vessels were built in 1936-1937 at a cost of $1,500,000. However, due to a P. W. A. grant, the actual cost to the city was $805,000.

Each ship carries a crew of 18 men, including a cook and a mess boy. Quarters are aboard for the crew to insure 24-hour operation of the vessel if needed to serve the treatment plants. Food is furnished by the city, and this writer can vouch for its quality and also the ability of the cooks.

In comparison with other methods of sludge disposal, the accompanying table reveals the cost of operating the sludge vessels in 1939.

TABLE I—COST OF OPERATING THREE SLUDGE VESSELS FOR THE CALENDAR YEAR 1939

	Sludge to Sea				Operating and Maintenance Costs		
Month	Cu. Ft.	Wet Tons	Dry Tons	Total	Per M. G. Sewage	Per Wet Ton	Per Dry Ton
January	4,579,000	143,100	3,102	$ 9,941.10	$1.87	$0.069	$3.21
February	4,282,000	133,800	3,444	11,344.50	2.16	0.085	3.29
March	5,141,000	160,700	4,581	11,312.60	2.04	0.070	2.47
April	5,390,000	168,500	4,943	11,201.60	2.02	0.066	2.26
May	5,448,000	170,300	4,948	11,555.80	2.08	0.068	2.34
June	4,968,000	155,300	5,381	13,432.60	2.38	0.087	2.50
July	4,829,000	150,900	4,932	11,390.40	1.97	0.076	2.31
August	4,792,000	149,800	5,230	12,151.70	2.05	0.081	2.33
September	4,820,000	150,600	4,606	12,022.00	2.22	0.080	2.61
October	5,036,000	157,400	4,601	11,145.20	1.97	0.071	2.42
November	4,642,000	145,100	4,625	11,333.80	2.28	0.078	2.46
December	4,844,000	151,400	3,695	11,100.30	2.20	0.073	3.00
Total	58,774,000	1,836,900	54,088	$137,931.50	....	.....	....
Average	.....	.....	.....	.....	$2.20	$0.075	$2.55

The distribution of annual cost of operating the sludge vessels is as follows:

	Total	Per Cent
Personal service	$ 97,947.29	71.01
Fuel oil	23,763.01	17.23
Repairs, supplies and maintenance	16,221.20	11.76
	$137,931.50	100.00

WILLIAM M. RAPP PASSES

An Honorary Member of A.W.W.A. With a Service Record of 55 Years in Atlanta's Water Department.

"Bill" Rapp, Sr.

With the passing of "Bill" Rapp on November 19th Atlanta lost its oldest employe in years of service. He had continuously served the Water Department of his native city for 55 years. Starting as office boy in 1885 he rose to become Superintendent of Construction and Distribution, which position he had held for the past 35 years.

When Mr. Rapp went to work in the Water Department Atlanta was but a small town with only 21 miles of mains. He saw it grow into a city, boasting more than 700 miles of mains and better than 60,000 services. In point of service he was the oldest city employee; in point of usefulness, there was none more so; in point of interest in the Department's welfare and love for his work, he was a "water works man" every minute of his life—and that frequently meant 1,440 minutes of the day, whenever duty called.

Mr. Rapp liked water works men and was, in turn, liked by all. There was nothing that he would not do to help a water works man solve a problem, or get out of a difficulty. He took an especial interest in promising young men entering the water works field, and instituted training courses for employees and many from other communities who came to Atlanta to learn under the "Master." He took a great interest in, and assisted with, the Georgia Water and Sewage Short Schools. He was active in water works association affairs, becoming a member of the American Water Works Association in 1899. By this Association he was recognized for his achievements in, and devotion to, water works matters and in recognition of his long and fruitful service. Being made an Honorary Member of A.W.W.A. in 1937 meant more to "Bill" Rapp than any reward that could have come to him.

Never satisfied with "good enough" as a way of operating and maintaining a water works system, Mr. Rapp spent all of his spare time in developing improved methods and inventing new things. In developing a clean sanitary yarn, to replace dirty jute in packing jute joints, he was several years ahead of his time. Other inventions were a method of cutting large diameter cast-iron pipes; the Rapp Tapping Machine; the Rapp Screw Plugs for closing the ends of cast-iron mains, tees, etc.; a mechanical joint for lead service lines to eliminate the difficult wiped joints; a method of cooling water to ground water temperature, without cost. A number of years ago he rated retirement on a pension—but, not "Bill" Rapp; he had work to do; that was his life.

Like brothers and partners worked "Bill" Rapp and his good friend and General Manager of the Department, W. Zode Smith, now in his 51st year of continuous service to Atlanta. Mr. Smith had this to say of Mr. Rapp: "He was a man devoted to his work. He was foremost a practical man, but one with a mechanical, searching mind who was constantly working on improvements. He saved the city thousands of dollars through his inventions and the methods that he developed." And Paul Weir, Sup't of Filtration, a protege of Mr. Rapp, called him "his best friend" and "a man who lived a life of unselfish service, which was crowned with a diadem of love for the affairs of the Atlanta Water Works." It is hard to add more than has been said by those who knew him best. To us he was all that a water works man should be.

Mr. Rapp, born in Atlanta in 1871, was 69 years old when he died. He is survived by his widow, a daughter and a son, W. M. ("Bill") Rapp, Jr., who represents a manufacturer of water works equipment.—L.H.E.

ANOTHER FISH STORY

(A News Item)

Goldfish Rallies on Bicarbonate of Soda

Kansas City, Nov. 26 (A.P.)—Nutzy turned pale and swam on his back, as all pet goldfish do when they swim toward fish heaven. His owner, Mary Graham Minor, massaged him with salt, but he got worse.

Bicarbonate of soda in Nutzy's bowl was suggested. It worked.

Now he's swimming with his fellows in as good form as ever—but the bicarb bottle's close by.

Well, when telephone calls begin coming in that—"Our very finest goldfish is dying because of those chemicals you are putting in the water," here's the Rx: "Bicarb, Madam—that's what your Nutzy needs.—Bicarb, Madam!"

EXPERIENCES IN PROTECTING WATER PIPES FROM FROST*

By F. J. RENY
Treasurer and General Manager
Portland Water District,
PORTLAND, MAINE

IT IS probable that the first attempt to protect water pipes in a dwelling house from freezing was to allow the water to run to waste. Most of us have been in the kitchen of a low cost dwelling and found the water running where the tenant had arranged a stick to reach from the faucet down to the sink so that the water could run and not splash. In fact, the best indication to the water inspector inspecting water fixtures that the running to waste procedure was being practiced was the stick which was always kept handy about the sink. Of course, this method of protecting water pipes is abhorrent to the water works manager and he will find some method to prevent this waste unless he has all the water in the world to run to waste and he figures that it does not cost him anything. In few cases, however, can this method be proclaimed as being efficient. It is the easiest way out for those who cannot protect their piping in any other manner. It is also true that many of these dwellings have no cellars at all, or if they have, they are too cold to install and protect a meter properly.

Experiences in Protecting Meters

Experiences with these kinds of installations have led to various methods of protection, one being the setting of the meter in the basement and building a wooden box around it, about 18 inches square, and the box being packed with sawdust or some other dry material which will keep the frost out. Others use a "meter-mitten," so-called, which is made of some fibre preparation and is the shape of a meter and can be put around the meter itself, leaving an air space by way of protection. I have never heard that these were successful, however. The installation of the meter in a pit outside is usually too expensive, unless it is the only way to install the meter to cover the use in the building.

Our experience with meter pits in the ground outside of the building involves those built of 2-inch hemlock plank nailed together with heavy spikes and heavy cleats to form the four sides of the pit. The bottom is about 4 feet square and the top

The Author

large enough to fit the iron frame, which is 24x29½ inches and contains a round cover 15 inches in diameter. These can be installed in the usual dirt street or sidewalk for about $35 and they give as little trouble as anything that has yet been devised. Smaller pits have been made of tile and other material but they are not sufficiently frost-proof for our conditions.

In some sections where buildings are set on posts and must be metered, we have placed the meter in the kitchen, where heat from the range protected it from frost.

Some have found that where heat is not available in the basement that on cold nights a lighted lantern will generate heat enough, if it is placed close to the meter, to prevent freezing of the meter.

Protecting Service Lines

The following are some of the rather common methods of protecting house services where buildings are not modern and the cellars are not heated with modern ranges or boilers. The most efficient method of protecting a house service, however, is sufficient cover to prevent the penetration of frost to the depth of the pipe. Experiments have proved that services which are laid with at least 5-foot cover are mostly always sufficient unless there is an unusual winter with a long spell of sub-zero weather and with very little snow cover. The lack of the snow blanket results in greater frost penetration and over a short time. We are laying all new water pipes five and one-half feet deep, which seems to be a safe depth.

Some years ago, during the period of very low temperatures, we had many complaints of frozen services. They were found to be mostly from sections where there was insufficient cover, usually less than five feet and sometimes less than four feet, and after thawing them out several times it was found necessary to advise the householder to let the water run, because we did not have sufficient crews to thaw them out every day. Of course, this could not be done in a great many water systems where water is pumped and where it is necessary to conserve the supply in every way possible. In our case, a list was kept of all the locations where frost had penetrated to the pipes because of insufficient cover, and during the next year all of the mains and services were lowered and given sufficient cover so that we would not have the same trouble again.

Pipe Insulating

Many kinds of insulations have been tried by water works to insulate services where sufficient cover could not be obtained and where expensive ledge excavation made the cost very high and it was a question as to whether it would cost less to insulate them or blow out the ledge. I confess that our experience in most cases has been that there is no substitute for installing the pipe below the frost line in the beginning, and many have found to their sorrow that a pipe insufficiently covered is going to give them trouble, and when they awake some cold morning and find the service frozen, they will then have to go to the expense of lowering the pipe to the proper depth. Ledge excavation is no longer the costly job that it used to be, and some local contractors will take out ledge for as low as 75c per foot with their own machinery.

The greatest hazard that we have found in winter time is around the salt water and the wharves. Most of these places are business houses, and where small amounts of water are used and where they cannot afford to pay for water wasted to prevent freezing, and some method must be found so that they can shut off the water at night and drain their service in order to avoid a freeze-up.

A rubber insulation was devised for copper service and tried out by

*A paper read before the Maine Water Utilities Association.

us on several water front locations. Thus far, the rubber covered services have not given us any trouble. Several installations were put in filling stations and in churchs where services were held in the church only once a week and where there was no heat during the week. The rubber insulation has served in these cases without giving any complaint.

What a Piece of Plank Will Do

Perhaps the most common form of insulation of water service that has been tried is the method used by the farmer who laid his pipe from the spring to his dwelling house not covered to sufficient depth and in order to avoid freezing he took an ordinary board and placed it on the pipe in the trench and filled in the earth around it. Investigation of this method has proved that the frost will not go through the wooden board and the board will stay a good many years before it rots underground and allows the pipe to be reached by frost. I have seen spring pipes which have been in the ground thirty or more years and with a covering of not more than 2 ft. 6 in., and yet the pipe had never frozen. The board seems to divide the frost when it strikes and the frost goes down on either side. Investigation of this method has shown us that worms will live under the boards through the winter.

Other forms of protection have been tried such as pipe covering or enclosing the pipe in a metal or tile conduit with an air space so that if freezing should occur, it can be disconnected and pulled out, but these are very much more expensive than the simple method of the wooden board. So much for services.

Protection for Mains

In regard to the protection of mains, many interesting experiences can be told about the protection of mains from frost. Most of us have seen water mains which have sufficient pressure and velocity exposed to the air all the year round with no danger of freezing whatsoever, because of the high rate of flow. We have in our Portland system pipe lines where the tops of the pipes are exposed but they have never been frozen. Perhaps the most exposed place in water mains is on bridge crossings where the flow through the night is less and the water in the pipe would be liable to freeze. In many cases, bridge crossings have been insulated in the following manner. A crew recaulks all of the joints to see that they were absolutely tight. Then a heavy coating of ¾ in. felt is wrapped around the pipe and held in place by copper wire. On top of this wrapping of felt there is another wrapping of ordinary 2-ply roofing paper which was also wound with copper wire. Care is taken all the time to break joints so that dampness cannot get in. Another wrapping of felt is then placed about the pipe over the roofing paper and another additional wrapping of roofing paper over this second coating of felt. A copper wire is then wound around the pipe so that the wrappings are about 3 inches apart and then all exposed or open places carefully covered with roofing cement. The entrances of the pipe line into the dirt or stone are also caulked in order to protect them as far as possible. Thus far the bridge crossings which we have insulated in this manner have never given us any trouble.

Water Warming

Perhaps the most interesting experiment in protecting a submarine line was performed by the Casco Bay Light and Water Company of Portland, Me. They send water through a 6-in. line from one island to another, and it was found that the temperature of the sea around the fresh water in the pipe would cause it to freeze because fresh water has a higher freezing point than salt water and therefore it was decided by the Casco Bay Company to slightly preheat the water with an electric heater before it started on its journey through the submarine line to the island, some 2,000 or 3,000 feet away. This experiment was very successfully accomplished and a paper describing this is being prepared for this association shortly.

Perhaps the most obvious form of protection noted in recent years was one in Portland which was installed by the United States Government through their contractor, where they laid a line of 1½ in. water pipe in the same duct with a steam line. It was found to be highly effective but the only trouble was that those who would occasionally like a drink of cold water found that this was impossible and that hot water was always forthcoming because of the close proximity of the water pipe to the steam pipes. The Government engineers were warned of this but took no notice of the warning and installed the service and in a few months the work had to be dug up and done all over again in a new location in order to be able to get a satisfactory supply of cold water.

The protection of water mains from freezing most always brings up the additional question of the protecting of submarine lines and it has been our experience in all cases that submarine lines should be laid in a trench and buried with sufficient cover to avoid the action of the cold salt water.

HOW TO BEND PIPES (And How Not To)

By W. F. SCHAPHORST, M.E.
NEWARK, N. J.

A question that is often asked is: "What is the best way to bend pipe"

By way of reply, the following experiences will probably be of interest:

To bend large pipes, fill with dry sand and plug the ends. Heat to a red heat in the localities to be bent and then bend. Be sure that the sand is dry. Where bends are slight, it is often unnecessary to use sand. The object of sand is simply to keep the sides of the pipe from collapsing, or to prevent reduction of flow area. If wet sand is used, and if the ends are plugged, the pipe may burst when heated, due to the steam pressure generated.

Instead of sand, resin is good. There is, however, a "right way" and possibly several wrong ways to use resin. An example of a wrong way was recently brought to my attention where the mechanic filled the pipe with resin, plugged the ends, and heated the pipe at the place where he wanted to bend it. He watched for a "red heat" just as he would had he filled the pipe with sand. The result was a violent explosion.

To use resin correctly, pour it into the pipe molten and allow it to cool and harden. As soon as the resin is hard, bend the pipe cold. Don't heat it. Then after the pipe is bent, heat the pipe all over sufficiently to melt and remove the resin.

Equal results may be secured by using lead instead of resin. I have been told that on cold days in the far North they sometimes fill the pipe with water and let it freeze, and then bend the pipe. It sounds plausible, but care must be exercised there on account of the expansion of water when it freezes.

Many excellent mechanical devices are on the market for bending pipe. To bend large, stiff pipe slightly (and inexpensively), there is nothing handier or more efficient, in my judgment, than a hydraulic pipe bender driven by a hand pump.

COST KEEPING*

By WALDO M. PORR
Asplund Construction Co.
ENID, OKLA.

THERE is something about the word "Cost Keeping" that immediately creates fear of the subject. It's too bad some other name cannot be found which will adequately cover it. I hardly know what to suggest but believe it would be better if we merely talked about "keeping track," because, after all, that is all we are doing. Cost keeping is absolutely easy. It is true, of course, that you cannot sit under the shade of a tree somewhere or in the grocery store with your feet on the stove and your hand in the cracker barrel and expect the desired information to hop upon the paper.

What Is This "Cost Keeping"?

There is not a one of you that wouldn't immediately undertake any ordinary bookkeeping job and yet cost keeping is so much easier than bookkeeping. Bookkeeping is very exacting. Every item must be properly entered both on the debit side and on the credit side of the ledger and must be correct to the penny. Cost keeping demands no double entries and no daily balances, nor is it tediously exacting. A penny error on the cost of 10 miles of sewer or water main would make very little difference in the cost per foot. Cost keeping is merely an understandable, relatively accurate summation of the expenses incurred. If you laid 10 feet of sewer and spent 10 dollars, the cost would be 1 dollar per foot. That is all there is to it; and, except for perhaps a little more explanation of this definition, we might stop right here.

Nearly every one of you have gone home some evening after losing several "bucks" at some game of chance and you have had a sudden flair for economy, and the best place to begin was on the wife, so you gathered up all the grocery bills and began checking up. Then you said: "Gladys, see here, in the last two weeks you have spent $4 for meat, 80 cents for butter, etc., so that we have a cost of $1.50 per day for groceries, 30 cents for meat; we cannot stand it." That is "cost keeping." That is exactly the same method and the same kind of result you can expect out on the job. It's all merely a checking of expenses and expenditures to determine what your work cost in the past and what you may expect it to cost in the future.

Because of the writer's familiarity with construction work, references and examples used are for construction costs, but the principles involved apply equally as well to operation and maintenance.

At What Does the System Aim

Of what do we expect a system of cost keeping to consist? First, a recording of facts pertinent to the construction. A list or record of all data relative to the work which may at the particular time or at any future time be of interest to anyone connected in any way with similar work. Second, a tabulation and translation of such records so that they may be readily understood for present and future guidance. The proper assembly of the gathered facts, so that they present a picture of conditions as they actually existed.

What do we expect to gain by the accumulation and tabulation of such data? After all, what good are they after we get them? The first aim should be more efficient production. "Well," you say, "they are no good for that purpose because I always construct my work in the most efficient manner." That may all be true, but all records point to the fact that some methods *are* more efficient than others. Without a record for comparison, how does your city governing body know but what some other methods or some other superintendent might be much more efficient. Or if they happen to get such a notion and it's wrong, how are you going to prove it wrong unless you have some evidence, some indisputable proof to show that your methods and your direction are more efficient. At the same time, it is very doubtful whether you are getting the most out of your work unless you know exactly what it is costing you. With the same organization day after day, as most of you operate, it is very easy for your production to decline so gradually that even you are unaware of it. Such a condition could be recognized only through comparison with past records. It is quite possible, too, for you to be using the wrong method and not know it. Unless you know what your work is costing and unless you know what similar work costs with other methods, you have no way of knowing that yours is the right way. This can be accomplished only through "Cost Keeping."

The second aim of cost keeping should be a truer appreciation of employees' efforts. On what basis are you going to allot wages? Who draws the higher wages, the fellow who produces the most work or the one who can tell the dirtiest story or furnish the most whiskey? If wages are to be paid in accordance with work done, then there must be some conclusive proof to show that the higher paid employees do actually produce more. Such proof serves as a protection for the employee, the city governing body, and yourself. It is not only a matter of wages, either. Suppose you are working a gang, all of whom do the same work and receive the same pay. How do you know that the gang as a whole is giving you a full day's work? Or if you are continually driving them for greater production, what proof do you have that they are not already producing more than can be reasonably expected of a man? Many labor troubles would have been avoided if a clear record of the conditions had been available to both the employee and the employer.

The third aim of cost keeping should be a higher production rate. A higher rate per man-hour, a higher rate per man day, per job day, and a higher rate for the entire job. When a complete system of costs, used properly and compared with other costs, enables you to weed out the inefficient practices and to improve upon the better methods, then your rate of production will gradually climb higher and higher and your costs will likewise become lower and lower.

The fourth aim of cost keeping, which might after all be summed up as the only aim, is one which is of vital interest not only to us, but to every man, woman and child, and that is more efficient government and consequently a lower tax rate. In this connection a proper system of cost keeping not only in the Water and Sewer Departments, but in all departments of government, could

*A paper presented before the 16th Annual Oklahoma Water and Sewage Short Course.

produce tremendous savings in the cost of operating our governments.

The Important Fifth Aim

But, from your point of view, there is a fifth aim of cost keeping and one which should be of more interest to you than any of the others and of more interest to you than to anyone else, and that is the opportunity for personal advancement. The man who is in demand today in the construction industry, both with private firms and government agencies, is the man who knows what work should cost and how to perform it so that it falls within that cost. Particularly valuable to any construction organization is the man who can pick up the plans for a proposed piece of work and state authoritatively what that work might reasonably be expected to cost. Construction companies are paying high wages for the man who can accurately foretell the cost of a job. The one and only way for you or anyone else to acquire this knowledge is through the keeping, studying, and using of proper cost records. If you want to advance yourself to a better job and better pay, study your job every day, learn more and more about it and all others like it. This ought to be sufficient reason for you to go after cost keeping in a big way.

Favored Methods

Cost keeping is expected to produce definite results. It is expected to furnish a permanent record of the whole cost and the unit costs of the work involved. If this result is achieved, it matters little by what method the results are acquired. While some methods are no doubt easier than others, while some methods are quicker than others, while some methods are more attractive than others, any one is quite satisfactory if it produces results. Of the many methods in use, some of which we shall endeavor to study, perhaps the most commonly used is what I call the "Envelope System," and is in a great many cases an excellent system. Most of them are old envelopes in which one has received mail. How handy they are for recording information gathered here and there throughout the day. How many times have you taken that old envelope out of your pocket and figured out how many pigs of lead you had used? How many times have you figured on that old envelope how much time you had spent in performing some given task? Keep it up. That's "Cost Keeping." That's the kind of cost keeping we are advocating. Often a superintendent is heard to say, "I don't need that stuff. I keep it all in my head." Perhaps he is right. Perhaps he can retain all the information by memory. If so, his head is bigger than most. But even so, don't keep such information in your head. You might lose your head some time. Besides, your head is needed for more important things of life.

In some instances the process of cost keeping has been advanced a little beyond the "head stage" and a little beyond the "envelope system" so that more satisfactory papers are used for records. In some cases such records are kept in the time book, which, after all, is an excellent system, as then the labor records and cost records are combined in one book. However, most time books are not so arranged as to be convenient for cost keeping notes. Various kinds and sizes of field note books are used for this purpose, including leather bound engineers' field books. For the average city or for the average small construction organization this is perhaps the most satisfactory system, as one can almost always find a notebook that can be easily arranged to suit the particular needs of the job. Of course, for the large construction organization, either private or municipal, the use of printed forms make it an easy task to quickly assemble the needed data.

At this time it is necessary for us to recognize one important fact about cost keeping. While the aim of every system is the same, you readily see that no two jobs are exactly alike, no two localities are exactly alike, and no two systems of operation are exactly alike. We cannot hope to furnish each of you with a definite system for keeping such records. We can only outline the general ideas involved and acquaint you with some of the methods as used by others so that you may get perhaps some one or two new ideas for developing your own system, which, after all, must be made up to suit your own needs and to fit your own particular work. No doubt many of you have already developed systems surpassing anything suggested here, in which case you will be conferring a great favor by revealing your ideas. Whatever method you pursue, whether it be in your head, on an old envelope, or on a prepared form, there is certain definite information which you must acquire and which you must record; not only record, but record in such a way that the record can easily be translated by you and by others familiar with construction work to produce data of some value. Such records must show not only all expenses and charges incurred on the job, but must show the distribution of such expenses or charges. It is not sufficient to say that a job cost $5,000. It is necessary to show what the various parts of the job cost. Nor is this all. They must show not only a general outline of the work performed, but a clear and decisive division of the work into the proper units. It is not sufficient to say that the job consisted of 1 mile of pipe line, it is necessary to show each item of operation and material that entered into the construction. Let us assume a hypothetical case.

In City "A," a water line was constructed at a cost of $1,000. In City "B" a water line was constructed at a cost of $1,500. Clearly such information means little without some basis of comparison. Then we learn that the "A" job was 1,000 feet long costing $1 per lineal foot, but at the same time we learn that the "B" job was also 1,000 feet long, costing $1.50 per lineal foot. Surely there is not that difference in efficiency between the two places. There must be some other differences between the two jobs. A further check into the two jobs shows both to be 4-inch lines, so we still have not found sufficient information to warrant the difference. Perhaps one was wood pipe and one cast-iron pipe. No, we find by further inquiry that each was 4-inch Cast Iron Pipe Class "150" and that each was installed with lead joints, each installed by hand labor, and both laid to the same depth. Now we have acquired considerable information and yet we are unable to reconcile the extra cost at "B." There must be more to it than this. Let us get the full information on this subject and see what we have. We now find that the "A" job consisted of the following: 120 cubic yards of excavation and backfill, 1,000 lineal feet of 4-inch Class 150 Cast Iron Pipe, 18-foot lengths with no specials, 400 lbs. of lead, 30 lbs. of jute, and that the "B" job consisted of exactly the same quantities, so still we have not explained the difference. Now if we subdivide the cost, in an effort to find something, we find the following:

CITY "A"

Item	Total Cost
Excavation	$ 48.00
Pipe	800.00
Lead	24.00
Jute	6.00
Haul and lay pipe	122.00
Total	$1,000.00

CITY "B"

Excavation	$ 570.00
Pipe	800.00
Lead	24.00
Jute	6.00
Haul and lay pipe	100.00
Total	$1,500.00

The big variation is in excavation and backfill. Why? Further examination reveals that the "A" work was in ideal soil. The "B" work in rock. That makes a big difference, doesn't it? Our completed report might now appear like this:

CITY "A"

Item	Classification	Quantity Units	Total Costs	Unit Costs
Excavation	Common earth	120 cu. yd.	48.00	.048 per ft. .40 per c.y.
Pipe	4" Class 150	1,000 l. f.	800.00	.80 per ft. 100.00 per ton
Lead	.....	400 lb.	24.00	.024 per ft. .06 per lb.
Jute	.....	30 lb.	6.00	.006 per ft. .20 per lb.
Haul and lay pipe	.....	1,000 l. f.	122.00	.122 per ft. 15.25 per ton
			1,000.00	1.00 per ft.

CITY "B"

Item	Classification	Quantity Units	Total Costs	Unit Costs
Excavation	Solid Rock	120 cu. yd.	570.00	.570 per ft. 4.75 per c. y.
Pipe	4" Class 150	1,000 l. f.	800.00	.800 per ft. 100.00 per ton
Lead	.....	400 lb.	24.00	.024 per ft. .06 per lb.
Jute	.....	30 lb.	6.00	.006 per ft. .20 per lb.
Haul and lay pipe	.....	1,000 l. f.	100.00	.100 per ft. 12.50 per ton
			1,500.00	1.500 per ft.

The only other place they differ is in laying pipe, which is less at "B." Then it would appear that the "B" work was more efficient in spite of the fact that it cost 50 per cent more. You have been given this little comparison in an effort to show how utterly useless cost records are unless they reflect the true conditions. This being true, let us consider some of the things for which we must provide in our record. The ordinary expenses on the usual job might be divided into the following groups: First, *labor*—which would include all field wages, salaries, supervision, inspection, operation, etc. Second, *material* which should include all items consumed in the work. Third, *supplies*—items not entirely consumed in the job and miscellaneous items not included with materials. This might include nails, bolts, kerosene, oil, shoring lumber, etc. Fourth—*equipment*—including all machinery and tools. Fifth, *overhead*—including office and kindred expenses.

Watch the Labor Items

Of all these the most important and most difficult one concerning the field superintendent is labor. Since labor is paid in money, in dollars and cents, it is customary to keep labor costs in terms of money, in dollars and cents. When kept in this manner, in order to compare records with those of another time or place, it is necessary to show the wage scale so that they can be compared on an equitable basis. To avoid this condition, some records are kept in terms of man hours, that is, instead of showing the dollars and cents certain units of work cost, the hours of work expended are shown. Such records can be applied to any locality by simply using the prevailing wage scale. Records kept in terms of both money and man hours are more to be desired. However, a variation in wage scales due to locality does not affect the cost as much as you would imagine. It has been general experience that work performed in other localities with labor at 20c per hour cost practically as much as in Oklahoma with labor at 40c per hour. An excellent part of any labor cost record is a statement of the average man hour cost. Some of your men probably draw 40c per hour, some 50c per hour, some 75c, some $1, some $1.50, etc. But what is the average rate per hour? You might be surprised how you can reduce the cost of your work by watching this one item alone.

Since most materials and supplies are purchased by the central office and since their cost is easily ascertained from invoices, we need not go into any lengthy discussion regarding them here.

Equipment Costs

Equipment cost keeping is, however, a difficult and important matter. Many a contractor has gone broke because he did not know what his machinery costs were. Many a city has done work with its own forces thinking this to be cheaper than contract work when if they really knew what their own equipment was costing they might find a different answer. Any equipment wears out and becomes obsolete, and whether privately or publicly owned, provision should be made for its depreciation and for its replacement. This cost can honestly and rightfully be charged to only one place, and that is to the work it performs. If you pay $4,000 for a crane, handle 4,000 tons of material, and then never use it again, your depreciation or replacement expense on the work is $1 per ton and you cannot get away from that fact. The reason it is difficult for the superintendent to keep adequate equipment costs is because usually such machinery is bought from funds of another source, perhaps even repairs are so purchased and he is not familiar with the cost involved. The Associated General Contractors of America have worked out a schedule for all kinds of construction equipment, which is a very good guide in charging equipment costs. Perhaps one of the most satisfactory methods is to establish an hourly, daily, weekly, or monthly cost for each major item of equipment which cost includes operation, transportation, fuel, oil and grease, repairs, and depreciation. If, however, you are renting a machine, then you have your cost well established.

Overhead Costs

Another part of construction cost keeping which does not as a rule fall under the duties of a field superintendent is that of overhead charges. But these charges are very much a part of the cost of such work and a very much greater part of the cost than most people imagine. The statement previouly made regarding equipment is even more true regarding overhead expense. This is the cause of much force account which could be done cheaper by contract if all proper overhead charges were applied to the force account work. Such items are a definite expense and are as much a part of the job cost as any piece of material and probably affect the total cost even more.

One item of major importance is the cost of moving from one job to another which with heavy machinery and long distances is considerable and is an item that does not depend upon the size of the job, therefore, is carried as a general expense item. Another item of importance to private constructors is the bond guaranteeing faithful performance of the contract and the payment of all just bills. Since bond costs vary with different classes of work, many cost accountants do not carry bond cost in with their unit job costs. This, however, is one item that will seldom be found in municipal costs. Another item of importance is insurance. This item covers fire and storm insurance as well as public liability and other insurance. In addition to these we have Workman's Compensation Insurance, which while it is a direct charge upon labor because of its variation in cost for various classes of work and for different localities, is

usually carried as a separate item. This item alone may amount to as much as 50 per cent of the payroll on certain jobs. Another item which is a direct charge on labor but is usually carried as a separate one for the same reasons is Social Security Tax. In addition to all of these there is always a great deal of office expense which belongs on and should be charged to the job. There are bookkeepers, stenographers, engineers, and others who are spending all or part of their time on the job and the expense thus incurred should be so shown even though they are paid from funds having no connection whatever with the work. So you see when you have determined all the expense on the job for labor, for materials, for supplies and for the equipment and tools you are only partially through. You still must add the overhead expense and you will be surprised to learn how large a percentage of the total this is.

Subdividing Costs

Having determined the major divisions of cost, we must now decide how these shall be subdivided. We could, of course, divide the costs down until we knew the cost for moving each shovelful of dirt or for laying each individual piece of sewer pipe. Obviously such subdivision would cost far more in keeping the records than they would be worth. We must decide upon some rational solution. We must devise a subdivision that will produce satisfactory records with the minimum of effort. A complete cost of waterworks pipe line construction for average extension jobs might be kept by dividing our costs in the following groups:

Clearing Right-of-Way
Trenching
Hauling Material
Laying Material
Preparing Joint Material
Pouring Joints
Caulking Joints
Tapping Main
Breaking Pavement
Replacing Pavement
Tunnelling
Wet Connections
Removing Old Joints
Removing Old Materials
Cleaning Old Materials
Cleaning Existing Mains
Backfilling
Settling Trenches

Under ordinary small sewer construction a complete record could be kept using the same items with the possible addition of:

Shoring
Building Manholes
Manhole Excavation
Building Flush Tanks

While these groups would furnish an excellent record, perhaps for those beginning the practice of cost keeping a sufficient record could be had by using only the following divisions for both sewer and water:

Trenching and Backfilling
Laying Pipe and Specials
Installing Corporation Cocks
Remove and Replace Paving
Building Manholes and Flush Tanks
Hauling Material
Setting Valves and Hydrants
Wet Connections
Setting Meter, Yoke, Curb Cock, etc.
Placing Risers

Of course, each of these divisions will need to be classified. For instance, the item trenching. Your report should show whether it was done by hand, team, or trenching machine; whether it was in common earth, loose rock, solid rock, wet earth, wet sand, dry sand, etc. Also the depth of excavation should be shown, as the depth has a great effect upon the cost per cubic yard.

We have mentioned hauling and placing material. This item will need to be classified, of course, into such items as joint material, pipe of various sizes and kinds, valves and boxes, meters, manhole covers, flush tank siphons, paving material, etc.

Establishing Unit Costs

Now in order to make our report comprehensible we must have a uniform method of reducing each item of expense down to unit costs, and in order to do this we must divide the work performed into convenient units. It is not sufficient to say that we spent $500 for excavation, we must say how much excavation, how many feet, how many cubic yards, or some other convenient unit of measure. Following the customary and general practice we might reasonably express work done in the following units:

Clearing—Acres
Trenching—Cu. yd.
Hauling—Ton
Laying—(Ton-lin. ft.—each—sq. yd.—etc.).
Preparing Joint Material—Lb.
Pouring Joints—lb.—each
Removing Paving—Sq. yd.
Replacing Paving—Sq. yd.
Shoring—M.B.M.
Tunnelling—Cu. yd.—ft.
Connections—Each
Removing Pipe—Lin. ft.
Excavating Manholes—Cu. yd.—each
Building Manholes—Each—lin. ft.
Cleaning Sewers—Lin. ft.
Backfilling—Cu. yd.
Settling Trenches—Lin. ft.
Wet Connection—Each

Recording

Having arrived at what we want to do, now how are we going to do it? If you are fortunate enough to have printed forms, you can easily fill them out. If not, then the notebook idea will probably fill your needs as well as anything. Suppose you use a double page for every day. Setting down on the left hand side the work completed and on the right side the cost, extending the total cost as well as the unit cost. At the end of the week use an extra double page to make a summary of your week's work and when the job is finished make up a summary of the entire job. Be sure to show, in some manner, all information relative to the job so that anyone can look at your report and tell exactly what you have done. If you will accurately keep a record of the labor each day, you can easily get the balance of information at your convenience. When you have finished the job, go to the office and determine what all of the overhead expense is and properly add it to your other expense. Now make a tabulated report of the whole cost and see that it is properly filed so that you or anyone else needing the information can find it. It won't do you any good to make the records unless you use them afterwards. Some interesting cost records for cities, aside from the subjects discussed here, can easily be made up from present records, and it would be enlightening if next year when you return you had some such records to compare with one another. For instance, it would be interesting to know what your maintenance costs are per mile of main, per capita and per thousand gallons of water. Also the same information on meter repairs. How many meters do you read per hour, how many inside meters, how many outside meters. What is your population per mile of main, per mile of sewer, etc. Such information will help you greatly in comparing costs. Compare your costs with published cost data which can be found in publications, such as "Engineering News Record," and in excellent books published on the subject.

Chart Pictures

Besides your notebook of costs and the tabulated results there are many other devices easily assembled which will give you an indication at any time as to how your job is running and which will be readily understood by those not familiar with construction work. When shown to the mayor, the city engineer, or political boss, who knows, they might mean dimes in your pocket, feathers in your cap. A man hour cost chart helps. Get a piece of cross ruled paper. Along the left hand side beginning at the bottom let each line represent one cent. If your lowest wage is 40c per hour,

then number the bottom line 40, the next 41, etc. Then across the bottom of the sheet beginning at the left let each vertical line represent a day. Each night divide your total labor cost by the total man hours worked and mark the spot on your sheet. Connect this spot with the previous day's spot and see if you cannot keep that line sloping down toward the right. When it goes up it means that your man-hour cost is increasing. Maybe you have too many high priced men on the job. Better investigate.

Make a progress chart for yourself, then show it to the boss. Take the same kind of cross ruled paper. Let each horizontal line represent a unit of work and each vertical line represent a day and draw your line from day to day as for the man-hour cost. For example, suppose you have a job 3,000 feet long and you expect to spend 30 days on the job. Let each horizontal line represent 100 feet, a day's work. Start at the bottom on the left hand side and number up, 0, 100 feet, 200 feet, 300 feet, etc., to 3,000 feet. Then start at the lower left hand corner and number the vertical lines to the right 0, 1, 2, 3, etc., to 30, representing the days. Now draw a straight line from where the two zero lines cross in the lower left hand corner to where the 3,000 feet and the 30 days' lines cross in the upper right hand corner. This line represents the progress you will have to make to finish on schedule. Each day spot on your chart on the proper day the total amount of feet you have finished, connect this spot to the previous day's spot with a line, and this line will represent the progress you are actually making. When the new line is above the original line you are ahead of schedule, and when it is below you are behind schedule. You or anyone else can see from a glance at the chart what progress you are making. There are innumerable charts of this nature that can be used.

You have been given here various suggestions for cost keeping. Perhaps you already have some of your own, perhaps your city already has prescribed methods. If so, by all means follow them. It is not our intention to discredit any method but merely to make suggestions where there is no present system.

Space does not permit a more specific explanation of various types of reports and charts with their uses. Perhaps at some later date additional and more interesting matter may be presented. In the meanwhile, remember that "Cost Keeping" is perhaps the easiest part of your job, and is likely to pay the greatest dividends.

CITY OF _____

Date _____ Daily Report No. _____

Job _____

Location _____

Work Classification	Total Hours	Rate

NAMES	HOURS PER KIND OF WORK										Total Hours	Rate
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
25												
26												
27												
28												
29												
30												
(Do not use this space)												

WORK ACCOMPLISHED

Amount												
Units (sq.yds., ft.,etc.)												

MATERIAL						REMARKS
KIND	Size	Amt. Recd.	Unit	Amt. Used	Unit	

Weather Condition _____ _____ Foreman

NUMBER REPORTS AND DELIVER TO OFFICE EACH DAY

A Suggested Simple Report Form

[*Note: Numbers* 11-24 *inclusive dropped from form to save space in reproducing it.* —*Ed.*]

Leslie the Friendly Village

At the turn of the highway entering Leslie, Michigan, the visitor and stranger meets the sign here pictured.

What impressed us to the point of taking a snapshot of this sign was the fact that Leslie has listed as its foremost assets PURE WATER and GOOD SCHOOLS, and the very first thing of which this progressive community boasts is its water supply.

It was good to see this sign, and may Leslie prosper as the results of its No. 1 asset—PURE WATER—its friendliness and its hospitality.

WATER CONSUMPTION STATISTICS—1939

(Records from Plants of The American Water Works and Electric Co.)

Company	Approximate Population Served	Average Number of Domestic Customers	Per Cent Metered	Average Daily Consumption per Customer
Alexandria	36,800	6,388	42	158
Alton	38,200	7,857	84	102
Armstrong	8,500	1,931	0	239
Ashtabula	32,300	4,822	100	113
Atlantic County	21,500	4,027	100	88
Bangor	8,800	2,076	7	101
Bernards	8,400	1,006	100	116
Berwick	15,900	3,655	12	97
Birmingham	370,500	46,605	100	124
Bristol County	26,800	3,977	32	127
Butler	30,500	5,075	100	91
Cairo	15,500	2,296	25	144
Canawacta	3,900	813	3	73
Chattanooga	163,800	24,220	100	137
Citizens	53,200	11,337	100	82
Clark's Summit	5,100	1,018	69	85
Clinton	26,000	5,844	91	89
Cohasset	4,400	826	5	214
Commonwealth	154,300	20,671	100	181
Connellsville	16,900	3,024	58	109
Davenport	63,000	11,925	98	110
Dedham	20,200	3,946	100	135
Dennison	12,000	2,687	98	81
Dorchester	10,200	2,347	0	183
East St. Louis	174,500	28,445	100	87
Fort Madison	12,800	1,808	100	75
Glendale	2,000	274	100	82
Greenwich	35,500	6,244	100	264
Hallstead	1,900	481	3	109
Hingham	28,500	3,571	86	156
Huntington	86,200	15,663	100	118
Hyde Park	750	101	100	66
Joplin	36,000	7,169	87	109
Kokomo	37,500	7,074	99	92
Lexington	66,000	12,234	100	117
Marion	33,000	6,108	100	78
Merrill	8,600	1,163	61	91
Monmouth Consol.	112,500	17,303	92	153
Monongahela City	11,300	2,287	100	84
Monongahela Valley	32,000	4,869	100	101
Morgantown	29,600	4,772	100	113
Moundsville	17,000	2,682	100	82
Mountain City	10,200	1,814	30	84
Mt. Jewett	1,400	237	100	62
Muncie	52,700	9,251	100	118
Myerstown	2,800	714	64	65
New Castle	58,300	11,194	100	106
New Jersey	56,600	12,402	55	101
New Rochelle	114,100	12,439	100	232
Noroton	8,000	1,742	100	169
North Little Rock	29,400	3,535	100	105
Northumberland	5,800	1,184	25	106
Ocean County	13,400	1,175	0	200
Ohio Cities	17,500	3,368	100	83
Old Dominion	12,300	1,694	55	158
Osceola	4,000	727	31	85
Palmyra	5,900	1,214	70	70
Peoria	120,500	20,540	90	112
Port Chester	35,500	3,718	100	193
Ramey	7,000	1,477	1	61
Richmond	36,200	7,428	100	113
St. Marys	8,500	1,528	100	103
St. Joseph	84,000	14,769	64	99
South Pittsburgh	272,000	40,390	100	132
Spring	7,100	1,264	100	84
Terre Haute	68,800	10,986	100	105
Texarkana	29,400	4,914	100	119
Uniontown	22,300	5,141	100	114
Vandergrift	27,500	5,143	100	88
Wannacomet	9,150	1,209	0	212
Warren	15,100	3,248	99	112
Waynesburg	6,000	1,349	100	71
Westmoreland	65,700	11,154	91	100
White Deer Mountain	20,600	4,412	48	80
Wichita	118,000	21,130	100	160
Williamsport	55,500	11,727	100	82
Williamstown	4,100	720	100	184
Total or Average	3,277,700	535,558	91	123

TONS OF COAL IN LOOSE PILES

By W. F. SCHAPHORST, M.E.

Newark, N. J.

In Conical Piles

When coal is piled in a conical pile the tonnage in the volume is easily estimated from the formula $D^3 \times$ "C" where D is the diameter of the pile in feet at its base and "C" is a factor for the kind of coal. This formula becomes—

In Elongated Piles

For anthracite—$D^3 \times .00172 =$ tons
For bituminous—$D^3 \times .00248 =$ tons

But coal is often stored in elongated piles, in which case the tonnage of bituminous coal is computed from the formula:

$$(D^3 \times .00248) + (D^2 \times .00474 \times A) = \text{tons bituminous.}$$

Where A is the length of the "crest" on top of the pile in feet. A good way in which to determine the length of this crest is to subtract D from the total length of the pile at its base. D, in this case, is the maximum width in feet of the base of the elongated pile.

It is obvious that an elongated pile can be cut up into three parts. The two curved end portions when added together give us a pure and simple cone, whence we have the ($D^3 \times .00248$) in the formula. The central portion has a triangular section from end to end and its volume is one-half as great as would be the volume of a rectangular block having the same base and height. The tonnage in this central triangular portion is ($D^2 \times .00474 \times A$). Adding the two together we therefore have the combined formula given above.

When the coal in the elongated pile is anthracite instead of bituminous the formula becomes:

$$(D^3 \times .00172) + (D^2 \times .0033 \times A) = \text{tons anthracite.}$$

D and A are both measured in feet in all of these formulas which are based on the fact that one ton of coal occupies approximately 38 cu. ft. on the average, whether anthracite or bituminous. The natural cone of anthracite is only 0.25 as high as is the diameter at its base. For bituminous coal the height factor is 0.36 $\times$ the base diameter.

The Editor's Comments

DEAR SANTA CLAUS:

It was on this page in our pre-Christmas number of 1936 that we wrote you a letter asking for a number of things considered most needed in bettering the status of a great number of our deserving readers. For the most part this group is comprised of individuals holding positions of high responsibility and those all down the line who are rendering services to their communities which are markedly under-valued by city administrations and too little appreciated, if known of at all, by the citizenry they serve.

There were many favorable comments from our readers on the reasoning in the pleas contained in our 1936 letter, Dear Santa, and since we have just taken it down from the shelf, blown off the dust, and re-read it, we are of the opinion that conditions have not changed as much during the four years since it was written as we had hoped for. We must admit that some of the benefiting things which we asked that you help us secure have come to pass, and for these we are truly grateful, Dear Santa; however, many of the things asked for in 1936 will bear repeating again at this time.

Dear Santa Claus, the first thing on our list to ask of you is a higher and growing realization on the part of John Q. Public of the true value of the water works utility to his community—to him personally, and to his loved ones. That he will do a little private investigating to learn how very dependent he, his family, and his very livelihood and well being, are on the water works manager and his high calibre conscientious staff, when it comes to the most essential and important commodity in the life of a community—a wholesome, safe and reliable supply of pure water. Let him realize that he depends upon a service which cannot permit the least of letdowns or even an *occasional* failure. We ask that Mr. John Q. Public take a glance at the salaries paid from his town's treasury to various city officials, and consider whether more of his water rent or tax dollar should not go to these men responsible for management and operation of the community's No. 1 utility. We urge you to ask him to compare water works salaries with those paid for the city's legal services, and to other municipal officials carrying far less responsibility. We ask that he compare the remuneration of the water utility manager and his assistants with industrial managers in charge of plants representing the same approximate invested value, or those managers of industry having similar responsibilities. If he does this, we believe that Mr. John Q. Public will feel it his duty to bring organized effort into the city council to more equitably compensate the local water works personnel.

Dear Santa Claus, we ask for more city managers and politicians and public office holders who have sufficient grey matter, and sense of good judgment, to realize that the water works utility, above all other municipal enterprises, cannot be used as a political football, less hazard to public health and property, or serious damage to the purse of the community, caused through inexperience, is to be the result of such political tampering with the operating organization. Make the office holder realize that the water works must be no political "Christmas Tree" from which a rank imitation Santa Claus can pluck presents for the local butcher, baker and candlestick maker (this includes plumbers also), who come "well recommended" by some wardheeler.

Dear Santa Claus, we ask your help in procuring job-security for efficient and faithful water works and sewerage operators, to foil the type of office holder who insists on believing that "to the victors go the spoils." We need your help in getting some adequate form of security for those men who must lose their jobs for no good reason other than the thin excuse of "a needed shakeup." In this, Santa, some protection that has legal backing, such as operator licensing acts, for the present seems to us the most practical answer.

Dear Santa, in 1936 we asked for your influence with municipal and state officials in the matter of getting established pension systems for the benefit of water works and sewerage employees who unfortunately are automatically excluded from benefits under the Federal Social Security Acts, involving supporting pensions in old age or disability. While we sincerely hope that the pending bills in the U. S. Senate and House, or better ones if introduced, will result in municipal employees benefiting through the Federal Social Security Act, it is our thought that years of lean pay and faithful service warrant a more adequate retirement fund than the Federal Act alone provides.

And, Dear Santa, we asked for workable Federal legislation for the purpose of coordinating state activities in securing and maintaining cleaner streams and water-ways. This came close to a realization during the year, and we are still hopeful that some National program is to result, in the interest of standardization of policy and action in all states, and in equitable dealings with all polluters alike.

Dear Santa, we again ask that you send us more local editors who will take a higher interest in the water and sewage utilities and do the job, that can be so effectively done through the local press, of bringing the value of these public enterprises and their operating organizations to the deserved attention of the public. We also hope that you will help the managers of these utiltiies to become more publicity minded, not alone for their own good, but out of consideration for employees under them who will benefit.

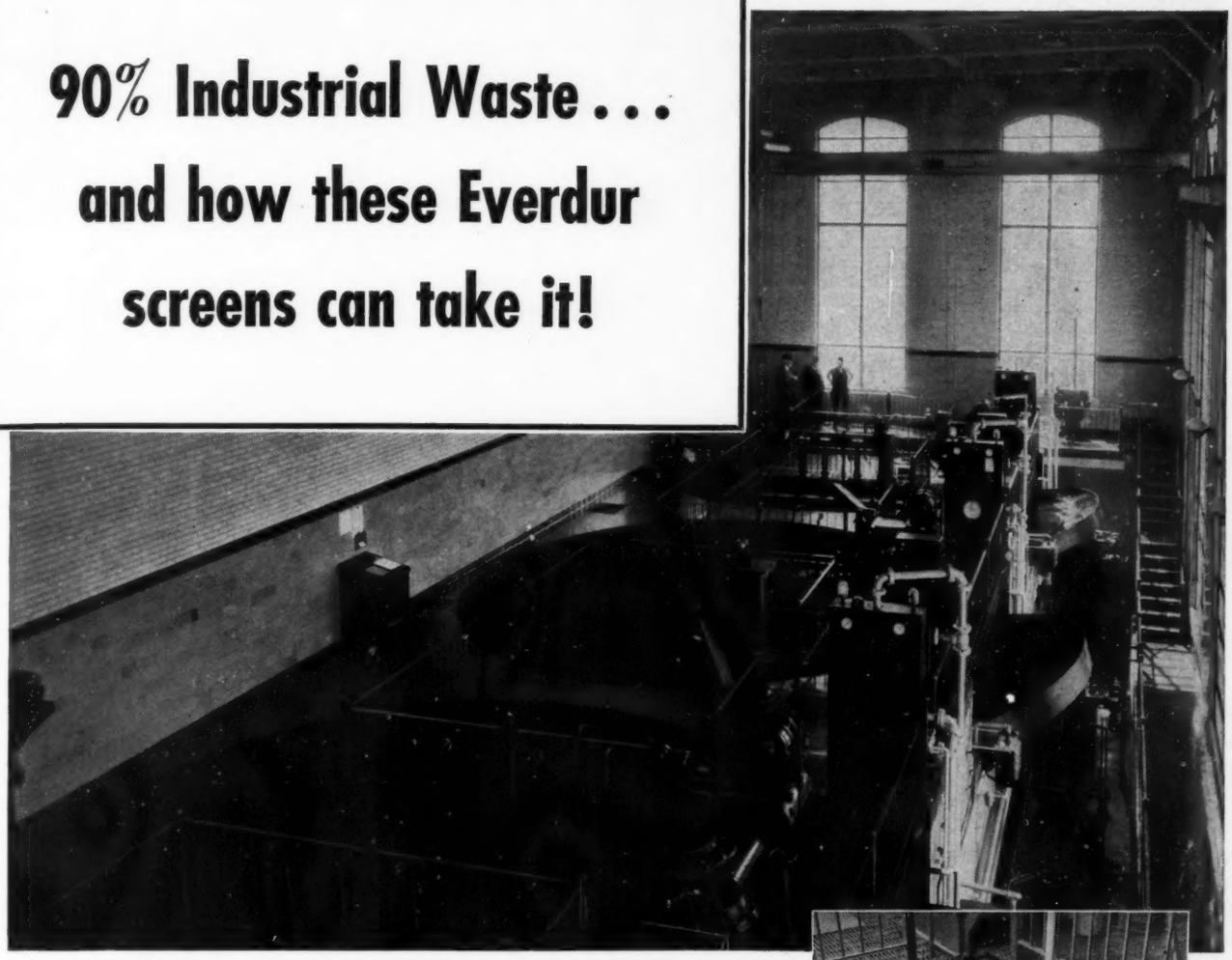
And, Dear Santa, we asked that you help the American Water Works Association to grow in strength and thereby, in its influence toward advancement of the profession and *every* water works man who individually is in need of the help and support of a strong national association. Help its officers to put through the splendid program recently planned and to this end give A. W. W. A. the membership support it deserves and needs—especially the growth in Corporate Memberships and consequent support from municipalities, which have already benefited so much through the activities of A. W. W. A. and may benefit even more.

In this last request, Dear Santa, you have in splendid fashion answered our prayer, except that the desired support of municipalities through Corporate Memberships has not been as strong as it should be. On the other hand, A. W. W. A. struck a magnificent stride in growth of individual memberships, and this continues unabated. More than that, never have the wheels of production in A. W. W. A. hummed as loud, in the grinding out of official specifications and other documents of value to the water works profession, as in the four years since our 1936 letter was written.

Dear Santa, we thank you for sending A. W. W. A. a Harry Jordan as Executive Secretary, and the splendid "wheel horses" of the A. W. W. A. who have pulled the load so magnificently.

L. H. Enslow

90% Industrial Waste . . . and how these Everdur screens can take it!

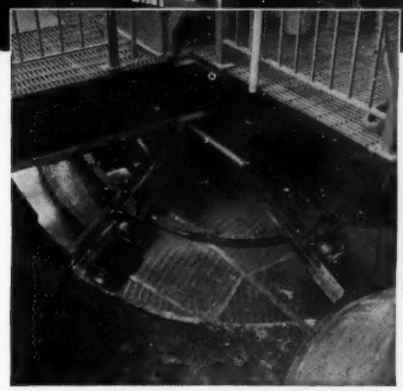


Slotted silicon-bronze plates stand up under constant contact with sewage having a strength varying from an average of 217 p.p.m. suspended solids to as high as 1395 p.p.m.

At the new Niagara Falls Sewage Disposal Plant, the filters must contend with the corrosive influence of sewage highly saturated with industrial wastes from chemical manufacturing, paper and abrasive concerns.

To handle this sewage . . . 60 million gallons of it . . . there are six rotary filters with Everdur plates, machine-slotted 1/32″ wide . . . providing 43% effective open area. Everdur copper-silicon alloy was chosen for this rigorous service on its 15-year record of long, efficient and economical service in sewage treatment plants.

Everdur is rustproof . . . highly resistant to corrosion . . . and, although possessing great strength, can be fabricated economically by all common methods. What's more, the initial cost of this valuable alloy is moderate. A full explanation of Everdur's wide use, not only for screens but also gates, effluent and scum weirs, etc., is given in Anaconda Publication E-11. Ask for a copy. 40187



Looking down one of the six rotary filters made of slotted Everdur plates installed in the Niagara Falls Sewage Disposal Plant by San-Dis Engineering Co., Buffalo, N. Y. Plates are covered with a thin mat of filter media. Sewage solids are collected on the filter mat and both solids and filter media are removed and incinerated. E. J. Smith, *Plant Superintendent;* L. G. Rice, *Consulting Engineer.*

ANACONDA
from mine to consumer

Everdur Metal

THE AMERICAN BRASS COMPANY, General Offices: Waterbury, Conn.
In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ont.
Subsidiary of Anaconda Copper Mining Company

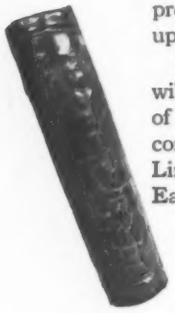
FOR EFFECTIVE PIPE PROTECTION

COATINGS must be WRAPPED with ASBESTOS FELTS

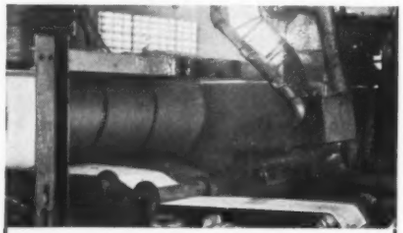
● Here's a money-saving tip to waterworks engineers. More than 25 years' experience in the oil and gas industries has proved many types of ferrous pipes must be protected by a corrosion-resistant coating. What's more, the coating must be reinforced or shielded with a strong, durable wrapping to prevent distortion and abrasion. And, for that service, asbestos—in the form of J-M Pipe-Line Felts—has proved the ideal material.

Because the asbestos fibers are inorganic and non-tubular, J-M Asbestos Felt cannot support capillary action. Tough and durable, it reinforces the coating against earth load and soil stress. And, because it is exceptionally resistant to the corrosive action of soil acids and alkalis, this durable felt gives efficient protection for the coating . . . helps keep upkeep costs to a minimum.

You'll be interested in the whole story. It will show you why more than 30,000 miles of pipe are operating at low cost under severe conditions. Write for the J-M Asbestos Pipe-Line Felt brochure to Johns-Manville, 22 East 40th Street, New York, N. Y.



UNWRAPPED BITUMINOUS COATING after exposure to clay-content soil. Soil stress has destroyed much of the protective coating.



THE SAME COATING, under the same conditions, but wrapped with J-M Asbestos Felt. The wrapping shows no signs of breakdown . . . the coating underneath is practically as good as new.

YOU CAN PURCHASE pipe from the steel-pipe mill coated with any standard coating material and wrapped with Johns-Manville Asbestos Felts. Or the same operation can be performed in your own yard by portable wrapping equipment supplied on a rental basis. Write Johns-Manville, 22 East 40th Street, New York, N. Y., for further information.

JOHNS-MANVILLE JM

ASBESTOS PIPE-LINE FELTS

MEETINGS SCHEDULED

Dec. 27, 1940—NEW YORK CITY, N. Y. (Commodore Hotel)
New York Section A.W.W.A. (Winter Get-Together Luncheon) Sec'y., Rollo K. Blanchard, 50 West 50th St., New York, N. Y.

Jan. 7, 1941—LACONIA, N. H.
New Hampshire Water Works Association. Secretary, Leonard W. Trager, State Dept. of Health, Concord, N. H.

Jan. 15-17—NEW YORK CITY, N. Y. (Engineering Societies Building)
American Society Civil Engineers. Annual Meeting. Sec'y., George T. Seabury, 33 West 39th Street, New York City.
(Jan. 16—Sessions of Sanitary Engineering Division)
(Jan. 17—Joint Dinner of the Division and N. Y. Sewage Works Ass'n.)

Jan. 17-18—NEW YORK CITY, N. Y. (Hotel McAlpin)
New York State Sewage Works Ass'n. Sec'y., A. S. Bedell, State Board of Health, Albany, N. Y.
(Jan. 17—Joint Annual Dinner with San. Eng. Div. of A.S.C.E.)
(Jan. 18—Joint inspection trip with San. Eng. Div. of A.S.C.E.)

Jan. 23—NEW YORK CITY, N. Y. (Engineering Societies Building)
American Society of Mechanical Engineers. (Evening Meeting Sanitation Group) Chairman, Wm. Raisch, Consulting Engineer, 227 Fulton St., New York, N. Y.

March 20-21—TRENTON, N. J. (Stacy-Trent Hotel)
New Jersey Sewage Works Ass'n. (26th Annual Meeting) Treas., Paul Molitor, Jr., Box 374, Morristown, N. J.

March 20-21—SYRACUSE, N. Y.
New York Section A.W.W.A. Secretary, Rollo K. Blanchard, Neptune Meter Co., 50 West 50th Street, New York, N. Y.

March (tentative)—LAWRENCE, KANS.
Kansas Water & Sewage Works Ass'n. Sec'y-Treas., Earnest Boyce, State Board of Health, Lawrence, Kans.

May 8-10—SEATTLE, WASH.
Pacific Northwest Sewage Works Ass'n. Secretary, Fred Merryfield, Oregon State College, Corvallis, Ore.

May 12-14—CHARLESTON, S. C. (Fort Sumpter Hotel)
Southeastern Section A.W.W.A. Sec'y-Treas., B. P. Rice, R.F.C. Healey Bldg., Atlanta, Ga.

May 15-16—CINCINNATI, OHIO.
Ohio Section A.W.W.A. Secretary, T. R. Lathrop, State Dept. of Health, Columbus, Ohio.

May 16—MISSOULA, MONT.
Montana Section A.W.W.A. Sec'y-Treas., H. B. Foote, Helena, Mont.

June 22-26—(1941)—TORONTO, ONT. (Royal York Hotel)
American Water Works Association. Annual Convention. Secretary, Harry E. Jordan, 22 E. 40th St., New York, N. Y.

Oct. 13-16—FORT WORTH, TEXAS
Southeast Section A.W.W.A. Secretary, L. A. Quigley, Supt. City Water Works, Fort Worth, Texas.

LITERATURE AND CATALOGS

Reilly Protective Coatings—Are the subject of a new brochure from the Reilly Tar and Chemical Corp. of Indianapolis, with plants in 14 other important cities, as listed. The illustrations reveal applications of Reilly coal-tar coatings and linings to water works and sewerage pipe line projects and plants. Methods of processing Reilly enamels are explained, the application procedure is outlined, and complete specifications covering the primers and enamels for various uses are presented. For a copy of "Reilly Protective Coatings," write the Reilly Tar and Chemical Corp., Indianapolis, Ind.

"Conversion Factors for Engineers"—Is both caption and context of a highly useful little reference book (4x6 inches) published by The Dorr Company. In it are 13 pages of tabulated conversion factors which were compiled and assembled a few years ago by Dorr engineers for use within the company. This little book places at the finger tip of the user every conversion factor that a sanitary engineer may be at all likely to need. For a copy, write The Dorr Co., 570 Lexington Ave., New York, N. Y.

[Although the most generally used of these factors, reproduced by permission of The Dorr Co., are to be found in the 1940 Reference and Data Number of "Water Works and Sewerage"—April 1940—the complete list in a handy pocket sized booklet possesses decided advantages.—*Ed.*]

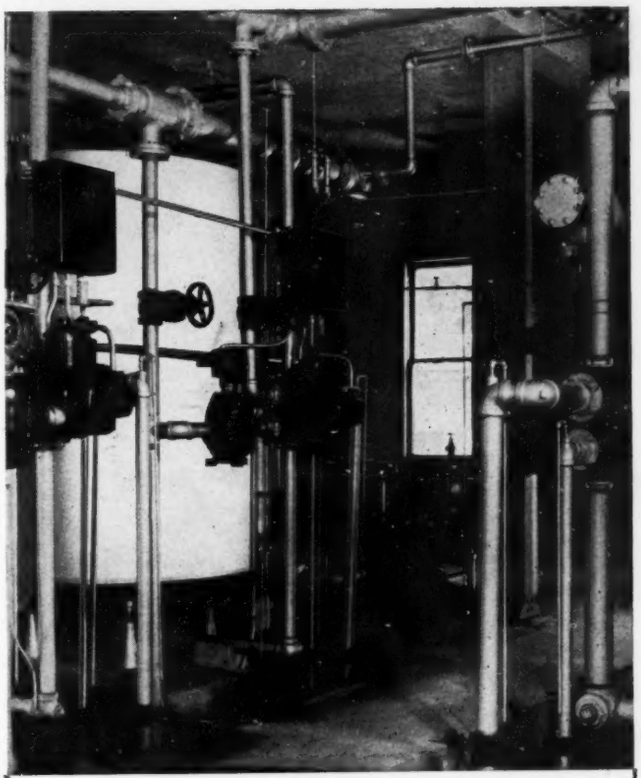
"Why Reinforced Concrete Pipe?"—Might have been the caption of the recently issued Bulletin No. 20, published by The American Concrete Pipe Assn. This pleasingly and instructively illustrated story by M. W. Loring, Secy. of the Association, is that of the new Concrete Pipe Pressure Aqueduct just completed by The Metropolitan District Water Supply Commission of Boston, and its relationship to the entire Aqueduct Project. It presents a profile and plan, and typical cross-sections of the complete tunnel and pipe aqueduct from Quobbin Reservoir through into Boston. Impressive are photographs of cross country runs of the still uncovered large diameter reinforced concrete pipe line constructed of pipes produced on the job to complete an important supply artery involving almost 80,00 ft. of 11½ and 12½ ft. diameter pipes, requiring 200,000 barrels of cement and 26,000 tons of steel. These giant pipes were supplied at a cost of $4,250,000 through a single contract awarded the Lock-Joint Pipe Co. of Ampere, N. J. (This the Bulletin does not reveal.—Ed.) The bulletin does relate, however, how these pipes were made, handled and installed and answers the pertinent question "Why reinforced concrete pipe instead of deep tunnel for this project?" It is an interesting story well told. For Bulletin No. 20 write M. W. Loring, Secy., The American Concrete Pipe Assn., 33 W. Grand Ave., Chicago.

[A companion bulletin (No. 21) describes methods employed in successfully jacking through an underpass of 8 ft. concrete pipes under an important 4 track railroad right of way.—*Ed.*]

"A.C.F." Lubricated Plug Valves are subject of a folder from American Car and Foundry Co., which emphasizes the several distinctive features of the "A.C.F." full pipe size opening cylindrical plug valves, the type that is now being increasingly favored for sludge, gas and air lines in sewage plants. These valves feature the "floating-plug" which is kept lubricated under pressure to preclude possibilities of its sticking in open or closed position. These valves,

Another City Now Has

SOFT, IRON-FREE WATER



City* in Indiana Installs Permutit Automatic Zeolite Water Softening Plant

Permutit equipment installed in this modern progressive city has capacity of 177,000 gallons per day. Water hardness 25 grains per gallon is automatically softened to 5 grains.

**Name on request*

Advantages of Automatic Operation

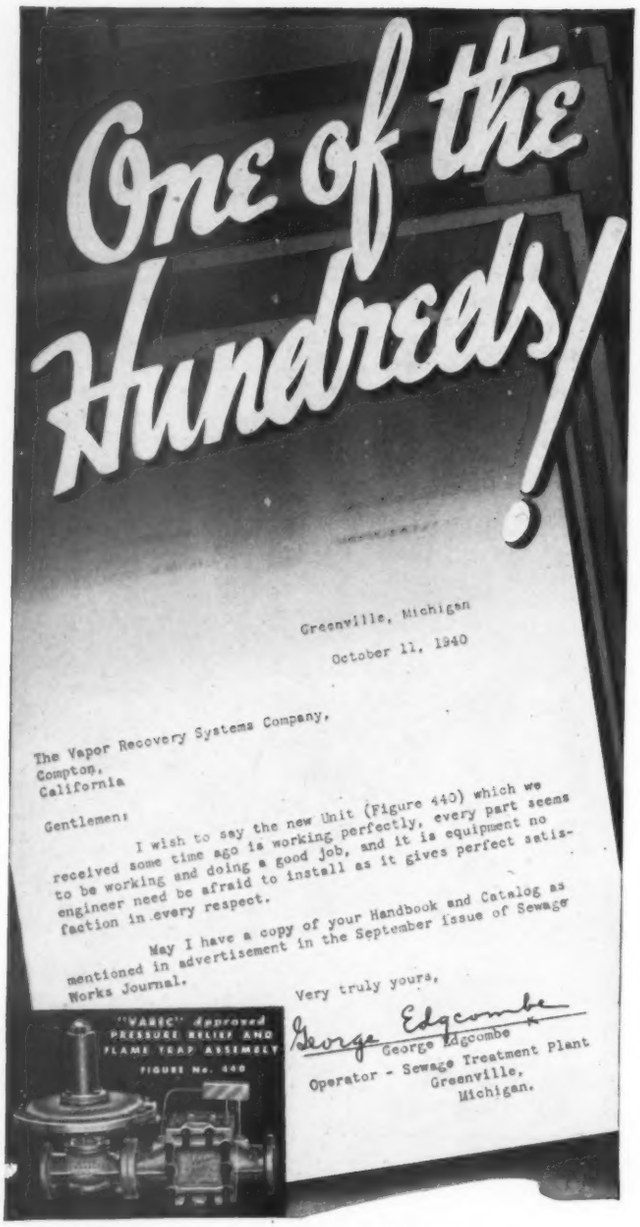
Perhaps the biggest single feature of Permutit Zeolite Water Softeners—the feature that appeals to large and small cities alike—is automatic operation. The water works operator can attend to his other duties without unexpected interruptions. The Permutit equipment automatically cuts itself out of service, backwashes, regenerates, and returns to service.

Automatic operation also saves on salt used for regeneration. And accurate control eliminates the chance for human error. The equipment above, installed in 1939, illustrates the compact, modern simplicity made possible by automatic control.

The number of cities enjoying Permutit water conditioning is steadily increasing. How about *your* city? For further information on installation shown, booklets on municipal water conditioning, free water analysis, or advice on any water conditioning problem, address The Permutit Company, Dept. G1, 330 West 42nd Street, New York.

ZEOLITE WATER SOFTENERS
SPAULDING PRECIPITATORS • IRON REMOVAL EQUIPMENT

PERMUTIT WATER CONDITIONING HEADQUARTERS


One of the Hundreds!
Greenville, Michigan
October 11, 1940
The Vapor Recovery Systems Company,
Compton,
California
Gentlemen:
I wish to say the new Unit (Figure 440) which we received some time ago is working perfectly, every part seems to be working and doing a good job, and it is equipment no engineer need be afraid to install as it gives perfect satisfaction in every respect.
May I have a copy of your Handbook and Catalog as mentioned in advertisement in the September issue of Sewage Works Journal.
Very truly yours,
George Edgcombe
George Edgcombe
Operator - Sewage Treatment Plant
Greenville, Michigan.
"VAREC" Approved PRESSURE RELIEF AND FLAME TRAP ASSEMBLY
FIGURE No. 440

"VAREC" Approved Products

- Pressure Relief and Flame Trap Assembly
- Flame Trap Assembly
- Pressure Relief and Vacuum Breaker Valves
- Flame Arresters
- Waste Gas Burners
- Flame Checks
- Back Pressure Regulators
- Pressure (Reducing) Regulators
- Check Valves (Non-chattering)
- Sediment Traps
- Drip Traps
- Manometers
- Pressure (Explosion) Relief Valves
- Manhole Covers
- Handhole Covers
- Sampling Hatches

PRESTIGE!

Backed by Service, Performance, Efficiency, and Economy, "VAREC" Approved Products for Gas Control are specified and endorsed by sanitary engineers the country over. The Sewage Treatment Plants of many cities, large and small, are living testimonials that years of design, engineering, research, and laboratory tests have not been in vain.

The "VAREC" Sewage Gas Control & Safety Devices Catalog and Handbook, S-3, is just off the press. It is profusely illustrated with photographs of actual installations, charts, diagrams, and prices. It's yours for the asking.

"THE PACE SETTER SINCE 1928"

THE VAPOR RECOVERY SYSTEMS CO.
2820 N. ALAMEDA STREET, COMPTON, CALIF.
Branch Offices—stocks carried
NEW YORK CITY TULSA, OKLAHOMA HOUSTON, TEXAS

illustrated in detail by a phantom view, come in all standard sizes, for ½ to 30 inches, with screwed or flanged ends. For a complete catalog of A.C.F. Lubricated Plug Valves write American Car and Foundry Co., 30 Church St., New York City.

"Unitrol" is Cutler-Hammer's copyrighted name for this company's new unit type of standardized construction of motor control units. "Unitrol" was developed to permit motor control devices of *all* needed types to be easily organized into a complete sectionalized but wholly enclosed Motor Control Center. The whole idea of "Unitrol" construction and assembly of built up units is primarily to save space and, incidentally, time, trouble, hazard, inconvenience, and, in the end, money. The illustrations in the C-H's "Unitrol" bulletin indicate to what extent the above aims are being accomplished by typical plant installation views and assembly picturization. The completed "dead-front" installation is a neat block of steel cabinets, in contrast to the old style control panels with dust catching instructments "hung on" its face. You simply open the individual doors and there is the protected unit. The most interesting aspect of the compact "Unitrol" design is the ability to change, extend or contract the control center as future requirements demand. In picturizing the old horse-and-buggy day design in comparison with the modern streamlined "Unitrol," the theme throughout the bulletin is "Not *This* but THIS." For publication CS-151 "Unitrol" write Cutler-Hammer, Inc., Milwaukee, Wis.

"Limitorque" Valve Control is featured in a new bulletin from Philadelphia Gear Works, which gives the reader an x-ray view of the operating parts within the compact cases of "Limitorque" motor driven control units for opening and closing valves of all sizes, and types or styles, up to 96 inch units. "Limitorque," as the name implies, limits the torque and makes manual or automatically controlled mechanical valve operation both safe and positive. In remote control of valves (gate, globe, cone or butterfly types) and gates in general, "Limitorque" safety insurance in operation is of especial interest. Pictures show the adaptation of this control unit to various types of valves—horizontal or vertical settings. Under "Fields of Service," the list includes water and sewage plants in which "Limitorque" control is employed. The number of installations in both steam and hydro stations of public utility companies seems indicative of its merits. For a copy of Valve Control by "Limitorque," revealing what makes the wheels go round," in the control unit, write Philadelphia Gear Works, Erie Ave. at G St., Philadelphia, Pa.

Victor Acme Rotary Blowers are subject of a new Roots-Connersville bulletin describing their Victor-Acme rotary positive blowers for handling small and medium volumes of air against pressure or under suction, ranging from 8 oz. to 7 lbs./sq. in. The bulletin not only describes the general operating principle of this two-impeller positive displacement type of blower, but contains a table of ratings of the several different sizes, also illustrations of the blowers in the numerous arrangements in which they are furnished. It also pictures and describes the several blower accessories supplied by "R-C." For a copy of Victor-Acme Blower Bulletin No. 21-B-35, write Roots-Connersville, Connersville, Indiana.

"Electrifugals" are the "All-in-One" pumping units recently developed by Allis-Chalmers of Milwaukee. These package-type close coupled compact centrifugal pump units (¾ to 25 h.p.), designed for installation in any position, are illustrated and described in considerable detail in a new A-C bulletin devoted to construction features, operating attainments and adaptability. Of interest to sewage works designers and operators, "Electrifugals" are available with splash-proof and explosion-proof motors. For Bulletin No. 6140, write Allis-Chalmers, Milwaukee, Wis.

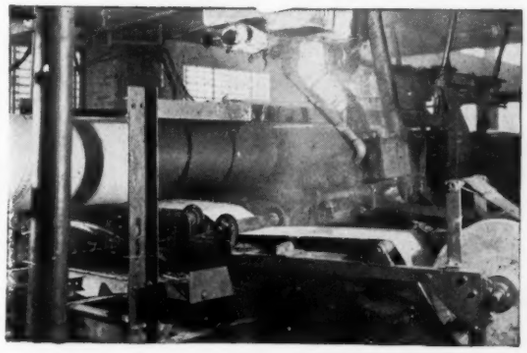
"The Mechanics of Filter Bed Agitation" is an expensively produced booklet of 68 pages published by Activated Alum Corporation of Baltimore, Md. This publication has been produced for the purpose of bringing together various published papers and discussions pertaining to improved filter-bed maintenance through adaptation of the new Palmer Filter-Bed Agitator, for which the publishers are agents and sales representatives. The introductory discussion of "The Mechanics of Filter-Bed Cleaning" is presented by Fred E. Stuart, President of Activated Alum. Thereafter follows individual success stories from users of Palmer's "Filtersweep." The authors are E. F. Dugger (Newport News, Va.); E. C. Goehring (Beaver Falls, Pa.); Henry F. Wagner (Buffalo, N. Y.); J. E. Rehler (Olean, N. Y.), and others. The final section of the brochure presents "Engineering Facts" relating to the design and functioning of the Palmer Rotating Agitator Mechanism. At the end is an impressive list of going installations now said to number 400 units in service in the remarkably short time that this device has been on the market. "The Mechanics of Filter Bed Agitation" can be had gratis by writing Activated Alum Corp., Curtis Bay Sta., Baltimore, Md.

Weather Instruments are presented in a complete catalog from M. C. Stewart of Arlington, Mass. Of particular interest to water works men is the Stewart Rain Gage—its special feature being the useful windshield. The gage consists of a standard 8 inch container, funnel receiver and measuring tube. The 8 inch container serves as a snow gage when funnel and inner measuring tube are removed. The windshield (featured) is aero-dynamically designed to eliminate turbulence and eddy currents and smooth out wind flow in order to procure a truer catch of actual precipitation. Thus is avoided the usual estimated error of 5 to 50% deficiency in catch by ordinary gages, not wind-shield equipped. The catalog describes and pictures the complete line of Stewart Weather Instruments. For a copy, and further information concerning the wind-shielded Stewart Rain Gage, write M. C. Stewart, 432 Massachusetts Ave., Arlington, Mass.

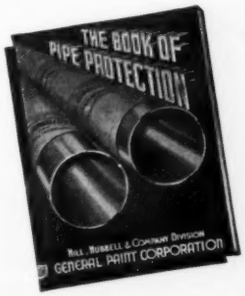
"Chemical Proportioning Pumps" are featured in a folder from Hills-McCanna Co. of Chicago, which presents thumb-nail descriptions and pictures of each of the 9 types now to be had. At the same time the folder serves as an announcement of the newest of the nine pumps—The Type "R" which has just been introduced as a low-cost unit to meet the growing demands for low capacity but accurate chemical feed pumps. The address of Hills-McCanna Co. is 2349-59 Nelson St., Chicago.

Use "Shatter-Proof"
STEEL PIPE
FOR
Permanent
HIGH FLOW CAPACITY

When STEEL PIPE is Lined and Coated-and-Wrapped by the HILL-HUBBELL "factory process" it has a 12% greater "C" factor. This assures PERMANENT HIGH FLOW CAPACITY and lower pumping costs. Because "shatter-proof" STEEL PIPE has extreme ductility, flexibility, and high tensile strength, it is not subject to sudden fractures and therefore the possibilities of breaks are reduced to a minimum. Use STEEL PIPE, Lined with BITURINE AKWALINE Enamel.



The illustration shows the HILL-HUBBELL "factory process" of MECHANICALLY Coating-and-Wrapping STEEL PIPE. The Lining of STEEL PIPE is also done MECHANICALLY. This method assures MAXIMUM PROTECTION.



WRITE for COPY

The Book of PIPE PROTECTION describes in detail how "shatter-proof" STEEL PIPE is MECHANICALLY Lined and Coated-and-Wrapped at the Mills under ideal conditions. Use your letterhead and write for a copy.

GENERAL PAINT CORPORATION
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FORD PIT COVERS

For setting large water meters the Pit Cover provides protection and desired flexibility. The cover alone is for a pit 2 ft. by 3 ft. and consists of a frame, ring, 20" lid and inner lid. One Extension Plate adapts the Pit Cover to a 3 ft. by 4 ft. pit and two Plates, as shown above, adapt the outfit to a pit 3 ft. by 6 ft.

WRITE FOR CATALOG

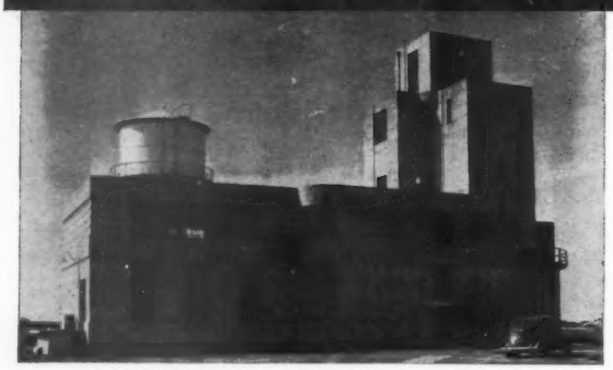
FORD METER BOX CO.

SETTING AND TESTING EQUIPMENT FOR WATER METERS

WABASH, INDIANA

FOR ALL WATER TREATMENT SPECIFY INFILCO EQUIPMENT

IT'S MODERN, EFFICIENT AND RELIABLE



City of El Reno, Oklahoma—Cooperative Water Plant

You are assured reliable water treating equipment, coordinated results and centralized responsibility when you specify "INFILCO".

Today, after years of designing and improving, INFILCO offers a complete line of field-tested water treating equipment that assures the ultimate in smooth, uninterrupted operation.

INFILCO does not limit itself to the manufacture of any one type of water treating equipment. It makes *all* types, (in many sizes), each developed to function as a part of a *complete* plant.

Whatever your requirements, you will find INFILCO Water Purification Equipment the leader in design and quality—in step with modern improvements.

INFILCO INTERNATIONAL FILTER CO.

325 W. 25TH PLACE, CHICAGO, ILL.

Worthington Portable Compressors with gasoline engine drive, are presented in a new Worthington bulletin. For the various sized units six types of mobile mountings are pictured. Features of Worthington's are emphasized in an enlarged cut of a four pneumatic-wheel mounted compressor available in sizes of 60, 105, 210 and 315 cu. ft. min. free-air delivery. Complete specifications in tabulated form cover the several units offered. For the new Bulletin No. H-850-B52B write "Worthington" (Compressor Div.), Harrison, N. J.

"The Pioneer" Tells of Super-Chlorination Progress—The "Pioneer" in this instance being the October number of "E. B. G.'s" meaty little monthly house organ bearing this significant name. The lead article relates the newest and most effective methods of super-chlorinating water to destroy or prevent tastes and preclude bacterial after-growths in distribution systems. Another interesting article pictures and describes working models of the outstanding early inventor, Leonardo da Vinci, in this instance inventions for lifting large volumes of irrigation water long before power driven pumping engines were conceived. Other subjects of interest in "The Pioneer" for October include "Water and Frostbite," "The New 'Dry' Water," "Air Vent Valves for Sewage Mains." To get on "The Pioneer's" mailing list, just request as much of the Electro-Bleaching Gas Co., 60 East 42nd St., New York City.

"Hyde-ro-Rings" for Joint Packing are the rubber rings developed for packing bell and spigot joints and named for the inventor, Ralph H. Hyde, manager of the Campbell (Calif.) Water Co. The folder being distributed illustrates the use of these sanitary packing rings, in which water superintendents have shown much interest because their use eliminates contaminating and bacteria harboring jute yarn. For a copy of this folder and a reprinted article, which fully describes "Hyde-ro-Rings," and how used, write Ralph H. Hyde, Box 1, Campbell, Calif.

Pressure Filters, by Cochrane, are the subject of a bulletin of 16 pages, which sets forth the features of Cochrane Pressure Filters. Illustration and installation diagrams accompany a tabulation of capacities and complete construction data. The bulletin also goes into an explanation of raw water preparation and filter operation. For Bulletin No. 2760, "Pressure Filters," write Cochrane Corp., 17th and Alleghany, Philadelphia, Pa.

Relief, Back-Pressure and Check Valves are covered in a 21 page illustrated Cochrane bulletin. Featuring the Cochrane Multi-Port Valve, the advantages of this many-parted valve, in providing increased protection, safety and freedom of operation in difficult service, are emphasized. For Bulletin No. 2870 write Cochrane Corp., 17th and Alleghany, Philadelphia, Pa.

"Synchronous Motors by Allis-Chalmers" is a new bulletin covering its larger Synchronous Motors. Besides covering their detail construction, it is well illustrated with interesting views of many significant installations. It shows various types of construction used in a number of different applications. Largest pumping installation illustrated is that on the Colorado River Aqueduct of three units of 4300 H.P. each driving pumps. The bulletin is made complete by covering types of starting equipment, including metal-clad and cubicle switchgear. For a copy of Bulletin B-6033 address Allis-Chalmers Mfg. Co., Milwaukee, Wisc.

"Blackhawk Hydraulic Equipment" is for the first time covered completely in a catalog from Blackhawk Mfg. Co. of Milwaukee. The production is a combination catalog and "Use" manual, illustrating many new products and applications which have never before appeared in print. The products include Hydraulic Hand Jacks; Gauge-equipped Jacks; Wheeled Floor Jacks; High-Pressure Valves; Remotely Controlled Jacks, and Hydraulic Pipe and Conduit Bender. A copy of Book No. 40H can be secured by writing Blackhawk Mfg. Co., Milwaukee, Wisc.

"Caterpillar Diesels On the Job" is the subject of a new and extensively illustrated bulletin from Caterpillar Tractor Co., of Peoria, Ill. Typical installations and performance history include Caterpillar Diesels in municipal power plants, and water and sewage pumping stations. At some sewage plants these economical power units are supplying all power requirements. After scaning the publication the principle reaction is that there certainly seems to be a "Caterpillar" for every job. A copy of Form 6056 may be had by writing Caterpillar Tractor Co., Peoria, Ill.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933

Of Water Works and Sewerage, published Monthly at Chicago, Illinois, for October 1, 1940.

State of Illinois, County of Cook, ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Edward S. Gillette, who, having been duly sworn according to law, deposes and says that he is the Business Manager of the Water Works and Sewerage and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:
Publisher—Gillette Publishing Co., 330 So. Wells St., Chicago, Ill.
Editor—L. H. Enslow, 155 E. 44th St., New York, N. Y.
Managing Editor—John Cecil Black, 330 So. Wells St., Chicago, Ill.
Business Manager—Edward S. Gillette, 330 So. Wells St., Chicago, Ill.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)
Gillette Publishing Co., 330 So. Wells St., Chicago, Ill.
H. P. Gillette, 330 So. Wells St., Chicago, Ill.
Winifred Gillette, 1125 Oak Grove Ave., San Marino, Calif.
Mrs. R. W. Hume, 303 S. Stone Ave., La Grange, Ill.
Provident Trust Company, 17th and Chestnut Sts., Philadelphia, Pa.
Louise Forsythe, 13 E. Windemere Terrace, Lansdowne, Pa.
La Verne Louer Hellyer, Ambassador Hotel, Chicago, Ill.
L. H. Enslow, 155 E. 44th St., New York, N. Y.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.)
None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the twelve months preceding the date shown above is —. (This information is required from daily publications only.)

EDWARD S. GILLETTE,
Business Manager.

Sworn to and subscribed before me this 9th day of October, 1940.
(Seal) KITTIE C. WOULFE,
Notary Public.
(My commission expires Feb. 8, 1942.)

Economy Dictates

DOW

Sludge Conditioning
FERRIC
Sewage Coagulation
CHLORIDE
Water Purification

35-45% Solution — **Shipped in Tank Cars**
60% Crystals — **Packed in 300 or 500 lb. Barrels**

For quotations and complete technical information, write today.

THE DOW CHEMICAL COMPANY
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HERE'S THE POINT WHERE GOOD WATER COUNTS
BE SURE THAT IT IS PURE AND SOFT BY INSTALLING
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For full particulars on equipment to meet your requirements, write Graver Tank & Mfg. Co., Inc., Dept. 3, East Chicago, Ind.
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OVER THREE QUARTERS OF A CENTURY OF DEPENDABLE SERVICE
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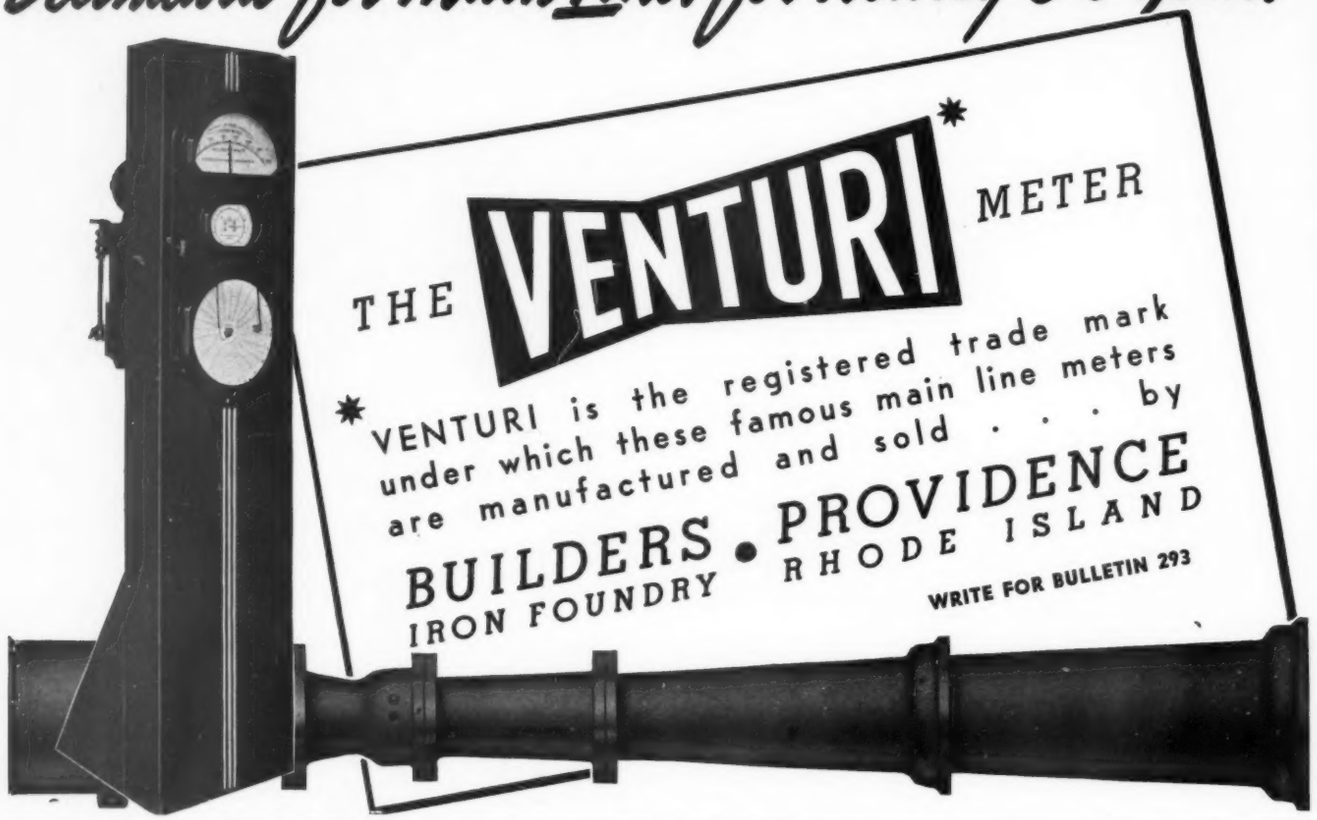
CABLE ADDRESS—GRAVANK

Standard for Main Lines for Nearly 50 Years

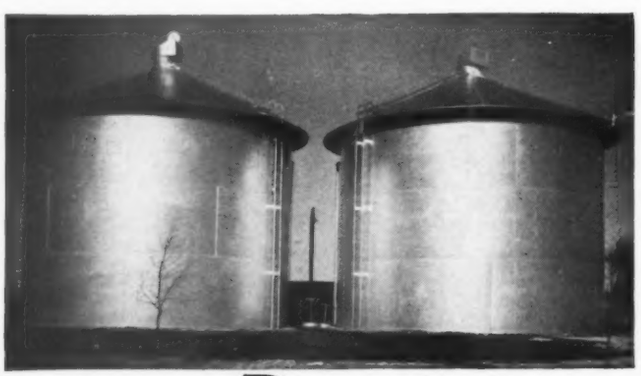


THE VENTURI* METER

*VENTURI is the registered trade mark under which these famous main line meters are manufactured and sold . . . by

BUILDERS IRON FOUNDRY • PROVIDENCE RHODE ISLAND

WRITE FOR BULLETIN 293



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Designed, fabricated and erected by the "Master Builders" in the water storage field. Low in first cost, with maintenance held to an occasional coat of paint. P.DM Steel Reservoirs provide the most economical means of storing water. They are guaranteed watertight, can be erected at any time of year, and will last for a lifetime. Let us send you our descriptive Bulletin No. 102—write for it today!

P.DM BUILDS BETTER *at lower cost!*

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Pittsburgh, Pa. . . . 3418 Neville Island
Des Moines, Ia. . . . . 919 Tuttle Street

AERO— FILTERS

(High Capacity Trickling Filters)

Provide complete sewage treatment at low first cost and low operating cost. Aero-filters for Economy. There are now more than forty-five installations in fifteen states.

Write for information.

LAKESIDE ENGINEERING CORPORATION

222 W. Adams St. Chicago, Ill.

EQUIPMENT NEWS

Test Set for Making Hydrant Flow Tests

● Northrop & Co., Inc., New York, N. Y., announces a new complete test set for making Tests for Hydrant Flows, Pressure and Loss of Head. The complete set consists of a Hand Pitot, Combination Hand and Clamp Pitot, three gauges and adapter for Tapped Hydrant Cap. One gauge has a double scale, reading in pounds pressure per square inch and approximate equivalent in gallons per minute, which makes it possible to take flow readings from 2½" Hydrant openings directly from the gauge.

The Pitots are both equipped with large air chambers and throttling cocks. Also the entire set is put together with ground joint unions, making it unnecessary to use wrenches or other tools. The Hand Set is sold separately as is the Combination Hand and Clamp Set. Instructions for Practical Methods of Making Hydrant Discharge Measurements, Computing and Applying Results are furnished with each set.

For literature giving a more adequate description and prices of various units of the set and the set complete, address Northrop and Co., Inc., 50 Church St., New York, N. Y.

New Caulking, Sealing and Waterproofing Compound

● American Bar Lock Co., Inc. has recently introduced ABLO Synthetic Rubber Compound for use cold in sealing, caulking and waterproofing operations. The product is applied with a gun or trowel. It contains no disintegrating resins, asphalt, or putty, and retains permanently its adhesion, elasticity, and waterproofing qualities. Rigorous tests have demonstrated its ability to seal glass laid horizontally over an opening exposed to the weather—a test generally recognized as the toughest for a sealing material. As described by the manufacturer, this compound does not deteriorate when exposed to weather; is resilient to the expansion and contraction of other materials; and does not powder, become brittle, crack, or otherwise disintgrate; is absolutely watertight; and adheres permanently to such varied surfaces as wood, stone, brick, concrete, metal, and glass. ABLO is supplied in cartridges for use with the manufacturer's special convertible cartridge gun, or in 1 or 5-gallon cans and 55-gallon drums. It may also be obtained in a heavy paint consistency for painting, waterproofing, rustproofing and preserving work.

Further information and literature completely describing ABLO and its uses may be obtained from American Bar Lock Co., Inc., Ablo Products Division, Long Island City, N. Y.

New Bronze Valves

● A new bronze globe valve, with stainless steel disc and seat, has been announced by the Reading-Pratt & Cady Division of the American Chain and Cable Company, Inc., Reading, Pa.

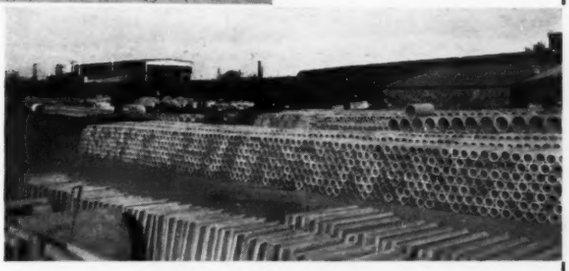
This valve has a full-plug type seat and disc, designed for throttling services on high pressure lines—water or steam. It is also suitable for use on high pressure lines carrying gritty substances which quickly wear ordinary seating materials.

Lubricant for Surveying and Other Instruments

● A lubricant to which dust does not adhere has been found useful in eliminating sticking of clamps, tangent and leveling screws of engineers' transits and levels. The lubricant consists of Acheson colloidal graphite suspended in carbon tetra-chloride. When applied, the carbon tetra-chloride evaporates, leaving a fine film of graphite serving as a "dry" lubricant. Information on this lubricant is available from Acheson Colloids Corp., Port Huron, Mich.

New National Airport at Gravelly Point, Washington, D. C. Over 60,000 ft. of 12"—60" Lock Joint Concrete Pipe used for drainage and sewerage.

Lowry Field, Denver, Colo. Part of more than 78,000 ft. of 6"—42" Lock Joint Concrete Pipe used at this airport. 18,000 ft. used for sewerage of buildings, quarters and barracks.



LOCK JOINT PIPE
FOR DEFENSE CONSTRUCTION

In Defense Construction speed is essential—but quality must not be sacrificed.

Ten permanent plants, strategically located throughout the country, carry large stocks of Lock Joint sewer, culvert, and drain pipe available for immediate use. On large projects, the pipe can be manufactured right at the site, using local labor and materials.

The recognized quality of Lock Joint Concrete Pipe is maintained through careful control of every process in its production, by men especially skilled in the fabrication of plain and reinforced concrete pipe.

Several of the many uses for Lock Joint Concrete Pipe in National Defense work include: sewers, culverts, drains and water supply lines for Airports, Army and Navy Bases, Municipalities, Power Projects, Factories, Railroads and Highways. Lock Joint Concrete Pipe can be supplied in sizes from 6" to 150" in diameter—and for pressures from zero to 600 ft. of head.

You'll find a representative at any one of our permanent plants prepared to help you in every way.

PLANTS ARE LOCATED IN THE FOLLOWING CITIES:

Denver, Colo.
Great Bend, Kan.
Kansas City, Mo.
Valley Park, Mo.
Rock Island, Ill.
Chicago, Ill.
Cleveland, Ohio
Kenilworth, N. J.
White Plains, N. Y.
Hartford, Conn.

LOCK JOINT *Plain and Reinforced* CONCRETE PIPE

LOCK JOINT PIPE CO Established 1905 AMPERE, N. J.

Rust Inside Steel Tanks is Expensive

An economical way to check it is with

RUSTA RESTOR
(Patented)

Cathodic Protection—the only positive method of rust prevention in tanks and their riser pipes.

Write for Literature

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1480 W. State St.
FREMONT **OHIO**

HYDRO-TITE

ONE POUND does the work of four pounds of lead. Much easier to use than lead and requires no caulking.

HYDRO-TITE joints are strong, very flexible and tight.

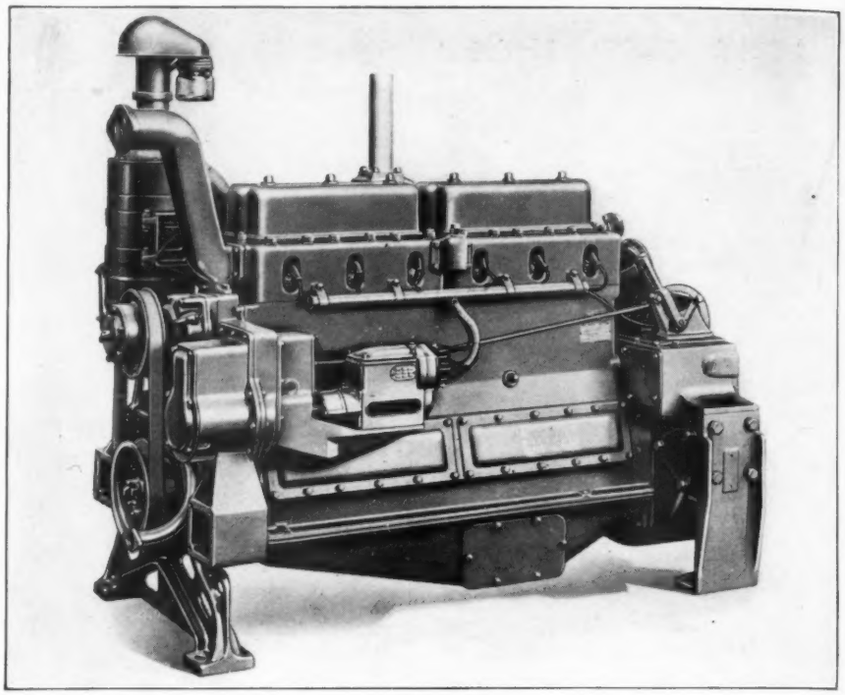
Write for our free trial offer.

HYDRAULIC DEVELOPMENT CORPORATION

MAIN SALES OFFICE—50 CHURCH STREET, NEW YORK
GENERAL OFFICES AND WORKS—WEST MEDFORD STATION BOSTON, MASS.

OVER 25 YEARS WITHOUT A FAILURE

Caterpiller Offers Gas Engines



● Three models of heavy-duty gas engines have recently been announced by Caterpillar Tractor Co. of Peoria, Illinois.

The larger engines are built in four and six cylinder units, both having a bore of 4¾" and a 5½" stroke. They develop 74 and 48 h.p. respectively at 1600 maximum governed RPM. A small four cylinder model, with a bore and stroke of 3¾"x5", develops 34 h.p. at 1650 RPM.

The three valve-in-head engines are designed for heavy-duty work with a minimum of maintenance. Heat resistant alloy valve seat inserts are provided on all models. The engines have superfinished crankshafts with "Hi-Electro" hardened journals.

The lubricating system provides efficient filtering and full pressure lubrication to all working engine parts. In addition there is an upper-cylinder lubricator to provide extra valve lubrication, when desired. A combination gas-gasoline carburetor is standard equipment although the fuel system is set for highest efficiency when using gas.

All three models of engines are available fan to fly-wheel, or as a complete power unit package with enclosed clutch and radiator. Electric sets, incorporating each of the engines coupled to a self-regulating generator (15, 20 and 30 kw), have also been announced.

For descriptive literature presenting these three new Caterpillar Gas Engines, just address "Caterpillar," Peoria, Ill.

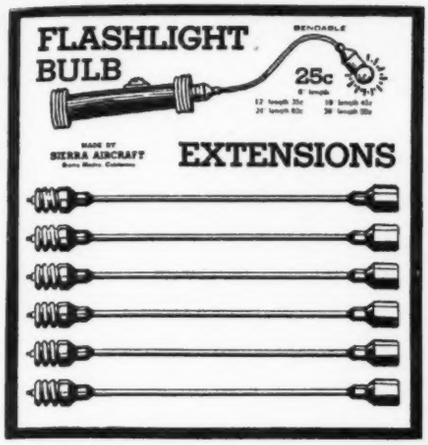
Storage Battery for Flashlight

● A rechargeable flashlight battery similar in principle to the well known automobile storage battery is announced by the Ideal Commutator Dresser Company, 1615 Park Avenue, Sycamore, Illinois.

Although small in size to fit all ordinary two-cell, 1¼ in. size D flashlight cases, it is claimed by the manufacturers to have been proved through actual heavy duty service to be dependable, long lived and economical. In heavy use one discharge is equal to a pair of ordinary dry cells. The rechargeable feature makes it convenient to use only while light is bright, and charge again when light gets dim. An ingeniously arranged chamber and vent plus semi-fixation of the electrolyte makes it spill proof. The case is of transparent Lucite.

A small charger consisting of transformer and rectifier plates makes it easy to keep the battery always fully charged by merely plugging in on a 110 volt, 60 cycle circuit. A clip is also available for charging from a 6 volt automobile battery. For large users a "gang charger" can be supplied.

Flashlight Extensions



● Most flash-light users, especially those working around machinery, have experienced the need for light at hard-to-get-at spots. Those who have will welcome the news that there is now available flexible extensions for flash-lights.

The accompanying illustration is sufficiently descriptive of the sectional extensions, which may be screwed end to end to suppy the needed length of bulb extension to reach the desired spot. Each section is 6" long and being bendable can be shaped to suit the user's needs in reaching around corners, parts of a machine, through bolt holes as small as 7/16" in diameter, etc., etc. Bent into a hook the extension permits banging the light at the needed spot and frees both hands to work.

An interesting aspect is that the bulb and extension are subject to immersion, if under-water light is desired. Use of the extensions also eliminates hazard to the user's hands around moving parts of machines and engines.

These Flash Light Bulb Extensions are available from the Sierra Aircraft Company of Sierra Madre, California.

Improved Safety Belt Line

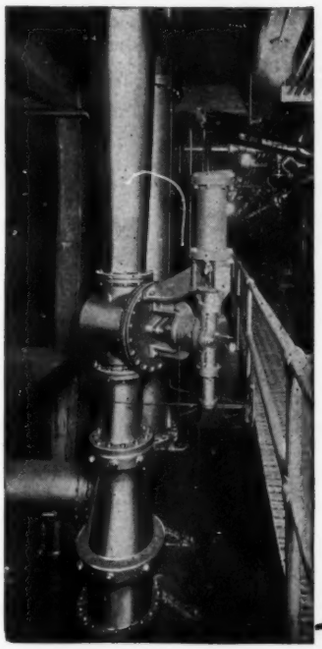
● The M.S.A. Steel Safety Belt Tail Line is a new Mine Safety Appliances Co. product. This new unit is a belt anchor claimed to possess high strength, excellent durability and versatility in application, supplying new freedom of action for the man on the job.

The Tail Line consists of an aircraft-type cable, light and flexible, yet tested to 3,900 pounds. Drop forged steel snaps at either end are swaged-on by the exclusive M.S.A. Velocity Power process which is claimed to provide a joint between snap and cable of strength equal to the cable itself.

The steel cable, available in any length, may be furnished with a covering for firm and comfortable grasp, resistant to weathering, oil and abrasive action. Complete details are pre sented in Bulletin No. CF-6, copies ot which may be secured by writing to Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh, Pa.

Which Primary Element?

VENTURI TUBE, FLUME, WEIR, ORIFICE, OR NOZZLE



The primary element for your metering application should be selected not arbitrarily but by the requirements to be fulfilled and by the economic considerations entering into the installation.

Sewage and sludge are often, though not always, measured by Venturi Tubes, Flumes, or Weirs.

Water may be satisfactorily measured by any type of primary element. Factors such as the cost of pumping, the pressure and the size of pipe or channel usually dictate the device used.

Steam is usually measured by the Bailey Orifice or Flow Nozzle.

Bailey Meter Company holds no brief for any particular primary element, its only interest is in making sure that the user secures the highest accuracy and reliability at the lowest expense.

Detailed information on the advantages of various types of primary elements furnished on request.

MU-18

BAILEY METER COMPANY
1072 IVANHOE RD., CLEVELAND, O.
Bailey Meter Company Limited, Montreal, Canada

As 1940 NEARS ITS CLOSE

. . . we extend Season's Greetings to the friends and friends-to-be of

ISCO
Ferric Chloride

We appreciate the privilege we have enjoyed of serving you and hope our pleasant relations may long continue.

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Established 1816
117 LIBERTY ST., NEW YORK
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THE NATIONAL METHOD
BEFORE CLEANING
AFTER CLEANING

CLOGGED PIPES
Made Good as New

THE NATIONAL METHOD OF WATER MAIN CLEANING makes your old pipe practically as good as new. Every department is subject to loss through the ravages of time upon its distribution system. The cleaning out of this foreign matter inevitably leads to increased pressure and flow, improved health conditions, and lowered operating costs.

Our illustrated Booklet, "The Cleaning of Water Mains," will be sent upon request.

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CIVIC PRIDE calls for TIDY STREETS

When pipe is to be laid, streets must be torn up. Don't let them *stay* that way any longer than necessary • Pipe jointing with *Tegul*-MINERALEAD means quick sealing of initial leakage, quick back filling, quick tidying up of premises, and, incidentally quick reduction of risk of traffic accidents • *Tegul*-MINERALEAD scores on other counts, too. Easy to handle and work. Ingot form, impervious to rain and flood. Can't change composition, with resulting trouble on the job . . . and the *cost*, too, will be a pleasing surprise • *Tegul*-MINERALEAD makes lastingly tight joints with flexibility to stand any vibration and ample resistance to mechanical and thermal shock • Write for full information and evidence of merit. The ATLAS MINERAL Products Company of Penna., Mertztown, Pennsylvania.

Tegul- ALEAD

for JOINTING BELL & SPIGOT PIPE.

WILSON CHEMICAL FEEDER

Outstanding features are quick feed adjustment, visible valves, flexible cylinders; feeds against 150-lb. pressure, and proof against corrosive chemicals.

Motor driven, positive displacement, pump type feeder. It is illustrated as a constant rate feeder though also furnished as Type MD-H with fluid meter control, and when so arranged is a measure-to-measure proportioning feeder.

This is a sturdy, dependable heavy duty feeder.

Write for Bulletin

Wilson Chemical Feeders, Inc.
BUFFALO, NEW YORK

When you think of
ALUM
. . . think of
ACTIVATED
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ACTIVATED ALUM CORPORATION
Curtis Bay Baltimore, Maryland

Plastic Packing

• The Crane Packing Co. of Chicago announce a new form of their "Super-Seal" plastic packing. It is now being made with a patented tape back reinforcement securely vulcanized to the outer surface of the packing. This vulcanized tape reinforcement replaces the old frictional woven cotton jacket and now a non-frictional surface bears directly against the moving part. Due to the tape back reinforcement, this new packing is extremely pliable and can be bent around small diameter rods and shafts without fracturing or cracking, or may be formed into small I. D. rings without distortion.

Super-Seal is a dry-graphitized plastic packing made from pure long-fibre asbestos, anti-frictional metal particles and special binders. It contains no oils that can be driven off by heat or pressure and the packing flows easily under bland adjustment.

"Super-Seal" in its improved form is available in six styles for various services and in sizes of ¼" to 1" graduated by 1/16ths. For complete details, samples and prices write The Crane Packing Company, 1800 Cuyler Ave., Chicago.

WITH THE MANUFACTURERS

Johns-Manville Honors "Ed." Phoenix

(J-M.'s Youngest 25 Year Man)

"Ed." Phoenix

• Edward A. Phoenix, assistant manager of sales promotion, in charge of industrial products for Johns-Manville Sales Corporation, was honored on December 3rd by a luncheon at the Hotel Commodore in New York. The occasion was his completion of twenty-five years of service with the organization.

During the luncheon which was attended by over 100 of his friends and associates, Mr. Phoenix was made a member of the J-M Quarter Century Club, honor society of the company's employees with 25 or more years of service. Lewis H. Brown, president of Johns-Manville, presented Mr. Phoenix with a gold watch, emblematic of membership in the Club, while colleagues gave him a gold watch chain and fob, and also a scroll in appreciation of his work.

L. R. Hoff, president of Johns-Manville Sales Corporation, H. M. Shackelford, vice-president in charge of sales promotion, and Arthur Elsenblast, staff manager in charge of filter products, also had some pleasant things to say regarding their association with "Ed." Phoenix, whose recent picture would seemingly belie such a span of service by a man so young. We wish him and "J-M" as many more years of the patently pleasant and fruitful association.

Michigan Alkali Rewards Old Employes on 50th Anniversary

(52 Have Service Record of 40 Years and Better)

• Michigan Alkali Co., one of the nation's largest and most important chemical producers, recently celebrated its golden jubilee with a banquet in honor of 567 veteran employes.

As a token of appreciation for their long service with the company, all 567 of the honor guests, with service records of 25 years of more, were presented with gold watches. Awards were made by company officials, including Emory L. Ford, president, and J. B. Ford, Jr., vice-president.

Fifty-two of the veteran employes receiving the token awards had been with Michigan Alkali for more than 40 years. Oldest in the group was James A. Wolcott, 77, of Wyandotte, and who has served the company continuously over the past 49 years, and now is the company's master mechanic.

Joe J. Pitt of Pittsburgh Equitable Dies

• Joe J. Pitt, West-Texas Representative for the Pittsburgh Equitable Meter Co., died suddenly in Fort Worth on Nov. 14th as the result of a heart attack. He was 47 years old.

Mr. Pitt was born in Val Alstyne, Texas. In the World War, he served in The Marine Corps. In 1930 he became Texas representative for the National Meter Co. and in September 1939 joined the sales staff of the Pittsburgh Equitable Meter Co.

Caterpillar's D. A. Robison Made Vice-Pres. and G. E. Spain Becomes Gen'l Sales Manager

● Caterpillar Tractor Co. has announced two important advancements in the company's organization.

Donald A. Robison has been made a vice-president of the company with administrative direction of all selling and advertising activities. The office of general sales manager, which Mr. Robison leaves to assume his higher duties is being filled by the advancement of Gail E. Spain.

Mr. Robison, a native of Nevada, has been associated with Caterpillar Tractor Co. activities since 1926, the year that he graduated from the University of Nevada.

Mr. Spain hails from Portland, Oregon. In 1920 he was graduated by Oregon State College, a mechanical engineer. By 1929 he had attained the position of sales manager for the Williamette Iron and Steel Works, of Portland. That same year he joined the "Caterpillar" organization and in 1938 was made manager of the company's Sales Development Division, from which position he has just been chosen General Manager of Sales.

Columbia Alkali Corp. Succeeded by Columbia Chemical Division

● Sale of chemical products manufactured by the Pittsburgh Plate Glass Company will be handled in the future by the company's Columbia Chemical Division, it was announced today.

Previously, the sale of such chemicals as soda ash, caustic soda, and chlorine, was conducted through The Columbia Alkali Corporation, a wholly owned sales division.

This action does not affect the personnel or sales organization. Mr. Eli Winkler, executive sales manager, and W. I. Galliher, director of sales, will retain their respective positions.

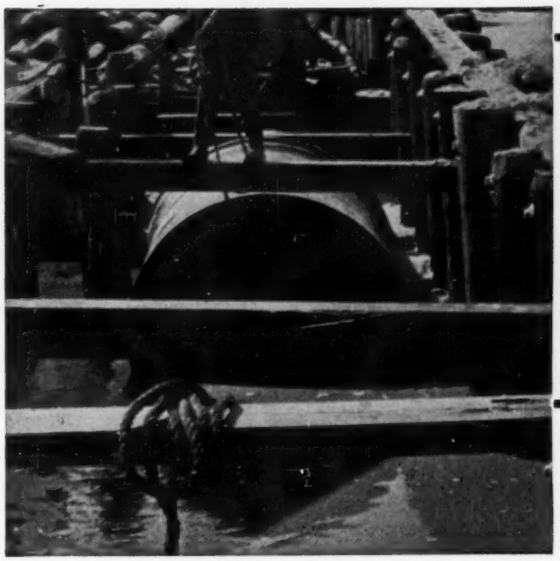
The status of existing contracts of The Columbia Alkali Corporation, and existing distributor relationships, will not be affected by the change.

"P. D. M.'s" W. Riley Workman Is Dead

Served His Company Almost a Quarter Century

● W. Riley Workman, Sales Engineer in the Dallas office of the Pittsburgh-Des Moines Steel, Co., died November 12th, 1940 following an operation.

Mr. Workman was born at Keosauqua, Iowa, January 14th, 1894; was graduated from the University of Iowa in the class of 1916 with a degree B.S. in Civil Engineering. He immediately associated himself with Pittsburgh-Des Moines Steel Co., which he has served continually during the last 24 years.



84" pipe—Spring Lake, N. J.

FLANGED PIPE
FLEXIBLE JOINT PIPE
BELL & SPIGOT PIPE
SPECIAL CASTINGS
SHORT BODY BELL & SPIGOT SPECIALS

Large stock enables us to make prompt shipments.

CAST IRON PIPE

SIZES 2" TO 84"

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IF Your SEWAGE effluents are high in suspended solids;

Or, you have a WATER PROBLEM;

Or, desire to RECOVER a product now wasted;

Or, you are disturbed by STREAM POLLUTION;

Or, are in any way interested in the removal of suspended solids from liquors;

You should investigate the

Laughlin Modified Rapid Sand Filter

BECAUSE, it is a simple automatic, continuous flow apparatus, designed on familiar lines, to accomplish a purpose without adding to the operator's troubles.

LAUGHLIN EQUIPMENT CORPORATION
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LEADITE
The Pioneer Self-Caulking Material for C. I. Pipe

YOU CAN'T GO WRONG WITH

The pioneer self-caulking material for cast iron bell and spigot water pipe which, for more than 35 years, has shown water works men how well it makes a good tight joint that improves with age.

THE LEADITE COMPANY
Girard Trust Co. Bldg., Philadelphia, Pa.

No Caulking

Prevent wear and cutting of rods, plungers, shafts and valve stems by using

MABBS RAWHIDE PACKING

In Your Water Works and Sewage Plants

IT LASTS LONGER—*Is Anti-Frictional, Saves Power, Labor and Repairs. Will prove the cheapest packing that can be bought.*

MABBS

Trade Mark Reg. U. S. Pat. Off.

Mabbs Hydraulic Packing Co.

Incorporated 1892

431 S. Dearborn St., Chicago, U. S. A.

EDSON'S NEW HAND PUMP

Smallest Diaphragm Pump Made, 2" Suction Open Discharge. Capacity 1400 G.P.H. Weight 50 lbs.

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Catalog "T" Gives Full Data, Also Edson Hand and Power Pumps, Suction Hose and Pump Accessories

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The Standard Material

for

Underground Mains

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The Meter-Master

RATE RECORDER FOR WATER METERS

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246 Palm Street, Hartford, Conn.

Dr. Bartow Joins J.-M.'s Research Laboratories

● Dr. Edward Bartow, granted a year's leave of absence as emeritus professor of the University of Iowa department of Chemistry and Chemical Engineering, has joined the research laboratories of Johns-Manville Corporation at Manville, New Jersey.

Dr. Bartow will act as Research Consultant in connection with chemical problems involved in all phases of Johns-Manville's research activities.

Sauereisen Appoints W. F. Bender Chief Engineer

● W. F. Bender, formerly associated with the U. S. Rubber Company, has been appointed Chief Engineer in charge of Engineering and Sales of the Sauereisen Cements Company, Pittsburgh, Pa.

Mr. Bender has had many years of experience in supervising the construction and installation of acid tanks, rubber linings, anti-corrosion equipment, which should prove very valuable in the technical and industrial cement field.

Worthington Pump Appoints New Traffic Manager

● R. A. Travisano, a member of the Traffic Club of Newark, N. J., well known to railroad and steamship officials in the New York metropolitan area, succeeds the late Mr. H. T. Smith as traffic manager of the Worthington Pump and Machinery Corporation. Mr. Travisano entered the employ of Worthington in 1912 as a stenographer. In 1915 he was transferred to the local traffic department at the Harrison Works. He was moved to the general traffic department in the New York offices of the organization in 1924, to handle the clearance of all exports of the corporation, as well as his regular duties of traffic department routine. Upon completion of the executive offices of the corporation at Harrison, N. J., in 1933, Mr. Travisano returned to the Harrison Works to become asistant to the late Mr. H. T. Smith.

Mr. Travisano, who lives at 41 Midland Place, is a life long resident of Newark. He attended Newark Public Schools, and is a graduate of the Merchants and Bankers Business College of Newark.

First Annual Engineering Essay Contest

● At its Annual Meeting on December 2nd, Hydraulic Institute, a national association of pump manufacturers, presented three awards to the winners of its First Annual Engineering Essay Contest.

This Contest was limited to the employees of the members of Hydraulic Institute and the subjects cover a direct contribution to the pump industry.

WESTON

GASKET AND FORM

The Perfected Method for Making SEWER PIPE JOINTS OF CEMENT

- No jute used—gasket centers spigot.
- Definite space in each joint for cement.
- Form confines cement-grout to lower portion of joint.
- Particularly advantageous in water-bearing trenches.
- Infiltration minimized.

L. A. WESTON **Adams, Mass.**

THE ENSLOW STABILITY INDICATOR

Provides Continuous Corrosivity Index

Base weighing 12 pounds can be removed, permitting wall mounting. Well constructed throughout. Art Metal Finish.

Write for Full Details

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RICHMOND, VA.

WILL SACRIFICE

This standard Trenching Machine to liquidate stock. Digs 22" trench to depth of 13'. Powered by Waukesha 55 h.p. gas engine. Can ship in 10 days. An exceptional value at only $3,750. Write Box No. 120, Water Works and Sewerage, 330 South Wells St., Chicago, Ill.

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CHEMICAL ENGINEER—with eight (8) years' experience in waste treatment and water treatment is looking for a position. Address "W. T.," % Water Works & Sewerage, 155 East 44th St., New York, N. Y.

IS YOUR NAME ON THE LIST?

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Rates: 1 year $2.00
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Two months additional for cash with order.

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Name .....

Title .....

Address .....

(Mail to 330 S. Wells St., Chicago)

Today—Simplex Sand Expansion Indicators are insuring wash water savings and greater efficiency of filtration in large and small—new and old—plants.

In plants whose capacities are as low as 1 m.g.d. and as great as 30 m.g.d. SIMPLEX SAND EXPANSION INDICATORS are proving their worth as an aid in securing proper filter washing. Longer filter runs and reduction in wash water usage are resulting in noteworthy savings. Let us show *you* how this inexpensive device will help you in reducing *your* operating costs.

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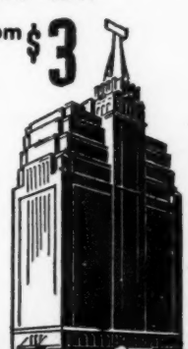
SIMPLEX VALVE & METER CO.
6743 UPLAND STREET • PHILADELPHIA, PA.

Finest Subway Entrance to all Points of Interest

New York's Popular
HOTEL LINCOLN
44TH TO 45TH STS. AT 8TH AVE.

OUR CHOICEST ROOMS From $3
1400 ROOMS each with Bath, Servidor, and Radio. Four fine restaurants acclaimed for cuisine.



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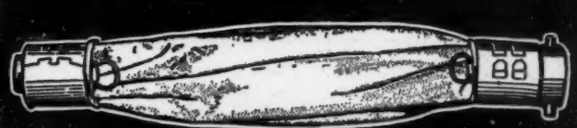
Whether your problem of water rectification is large or small, we have a form of equipment to serve your needs. We manufacture and install equipment for Gravity Filtration and Softening Plants; Pressure Filters and Zeolite Softeners; Swimming Pool Recirculating Appliances; and Water Treatment Units of all types.

ROBERTS FILTER MFG. CO.
607 COLUMBIA AVE DARBY, PA.

CUT SEWER CLEANING LABOR COSTS EQUIPMENT



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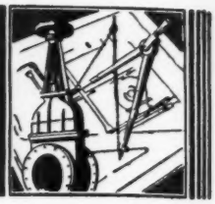
Specializing in the field of

WATER WORKS & SEWERAGE



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Civic Opera Building **Chicago**

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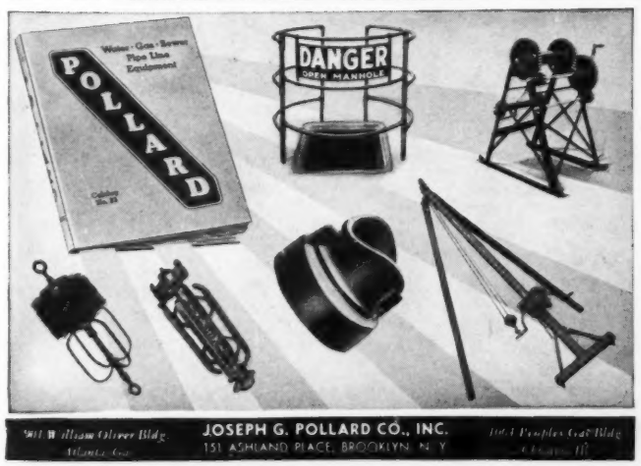

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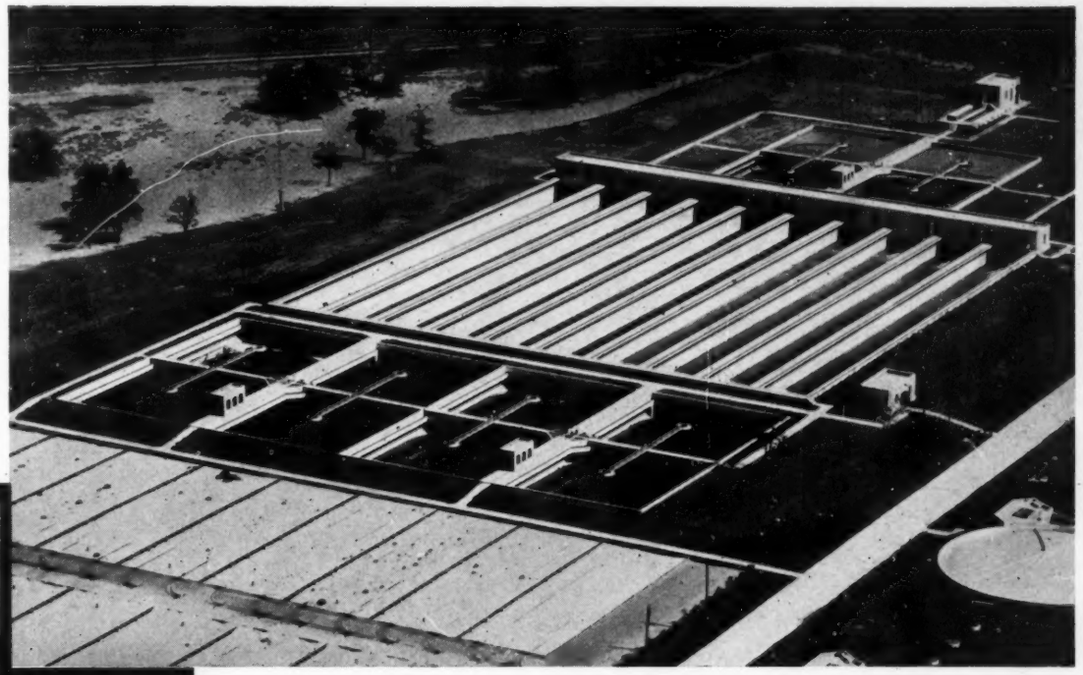
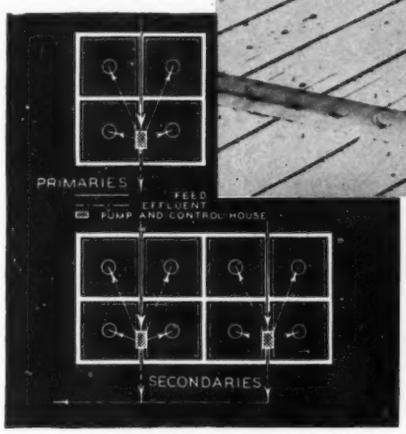


Gary, Indiana—8 secondary Dorrco Square Clarifiers in foreground; 4 primaries in background.



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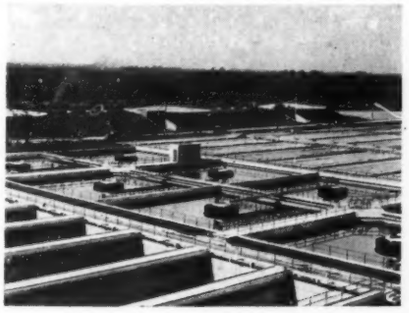
Close up of 8 secondaries; 3 Dorr Multdigestion Systems in background.



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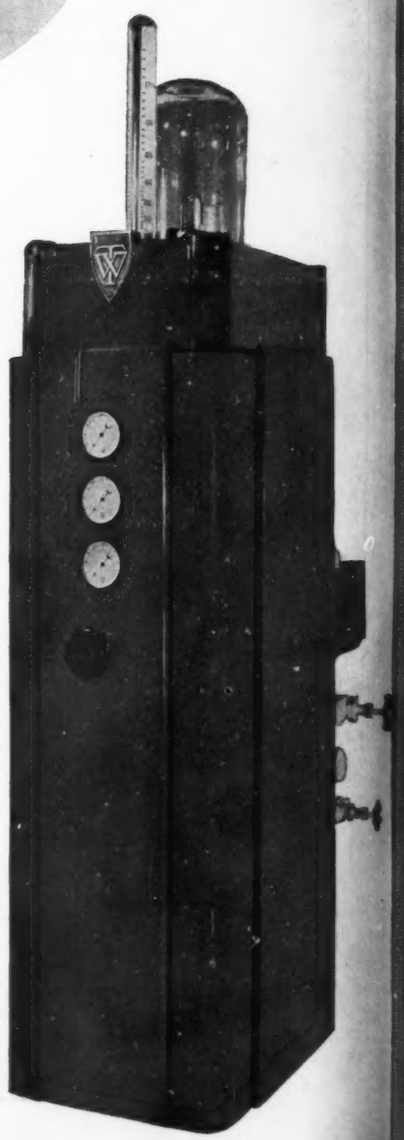

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